A Study of Diesel Pollutants in an Underground Production Metal Mine Using an Advanced Monitoring and Data Analysis Methodology

Final Report

by

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INTRODUCTION

A two-week air quality monitoring study was conducted during January 1984 in the INCO Little Stobie Underground Mine, Sudbury, Ontario. The study was part of a collaborative evaluation of LHD-mounted ceramic traps as a means of removing particulate matter from the diesel tailpipe emissions.

The air quality monitoring study was sponsored by CANMET. Personnel from CANMET, INCO, and Michigan Technological University participated in the on-site measurement effort as well as other phases of the study. The scope of work as outlined in our contract was as follows:

1. Provision of 3 days of consultation with CANMET personnel, plus preparation of the CANMET Portable Analysis Equipment for ultimate shipment to INCO one month in advance of the work at the INCO site.

2. Visit the INCO mine site and plan with CANMET and INCO personnel the details of the measurements to be completed by February 28, 1984.

3. Carry out the planned in-mine ambient CO, CO_2, NO, NO_2 and particulate matter measurements over a two week period: the first week being without the Corning particulate traps and the second week with the traps installed. A minimum of one engineer or scientist plus one technician from INCO and CANMET collectively will be available to collaborate in the data gathering processes.

4. Collect and analyze duplicate particulate samples (for total particulate, carbon and hydrogen) and Palmes' NO_x and NO_2 samplers to compare to CANMET measurements.

5. Analyze the data from the in-mine tests, write the final report to be submitted on or before March 31, 1984.

The ceramic traps (filters) were mounted, one on each bank of the Jarvis Clark JS500 LHD vehicle exhaust system. The ceramic material is manufactured by Corning Glass and canned by

Engelhard. Details about the filters, installation, and measurements other than those pertaining to their impact on the specific aspects of air quality discussed here will be covered in separate reports by the various parties to the investigation. The overall effort had a number of objectives as defined by Don Dainty of CANMET during the planning session held at INCO on November 21 and 22, 1983. These included the following:

1. Evaluate the durability of the filters in terms of useful life while mounted on an LHD.

2. Determine the impact of the filters on the mine environment including an assessment of the efficiency of particulate collection, and determine whether or not unusual amounts of CO or substances with high Ames activity are observed on-board or in the heading areas during use which may include high temperature burn off of the collected particulate.

3. Assess the effects of the filters, on LHD-operator exposure and on mine air quality with respect to the concentrations of CO, NO, NO_2, RCD, SO_2, and SO_4.

4. Assess the effects of ash buildup in the filters on engine back pressure and the possible catalytic effect of such ash on various pollutants (CANMET has observed CO reductions which have been attributed to the filters).

5. Train the CANMET researchers in the use of air quality monitoring instrumentation purchased under Contract 0SQ82-00152 (1).

This report addresses the research conducted for the primary purpose of accomplishing objectives 3 and 5. This research included daily simultaneous time-weighted-average concentration measurements for CO_2, CO, NO, NO_2, particulate matter (RCD and total), and SO_2 (or SO_4). Four locations on the 1400-foot level of Little Stobie Mine were monitored. The first was upstream of the operation in the ventilation system, the second was on-board

the LHD near the operator, the third was in the stope (or heading) near where the LHD was mucking, and the fourth was in the return downstream from the study area in the ventilation system.

One week of measurements involved the normal INCO LHD dual exhaust system which contained a PTX catalytic convertor on each bank. For the other week of measurements, each catalytic convertor was replaced by a ceramic filter trap.

DESCRIPTION OF THE MINE AND MEASUREMENT METHODOLOGY

The study was conducted in a relatively small area of the mine (less than 500 feet between extremities). Figure 1 illustrates the mine area as it was during the first week of the study (January 9-13, baseline with catalysts) and Figure 2 represents the second week (January 23-27 with ceramic traps) after additional mining had taken place during the week between the two study periods. The most evident difference between the two study weeks is that the small drifts around the perimeter during the first period (Figure 1) virtually disappeared when the ore separating them was mined out (Figure 2). There was also relatively little drilling the second week. The anticipated effect of eliminating these drifts would be to somewhat reduce the peak concentrations to which the LHD operator was exposed. However, all were relatively short during the first week so that nearly all of the LHD exhaust was emitted into the open stope. The effect of the greater amount of drilling the first week would be to produce particulate matter which cannot be distinguished from diesel particulate by the elemental carbon and hydrogen analyti-

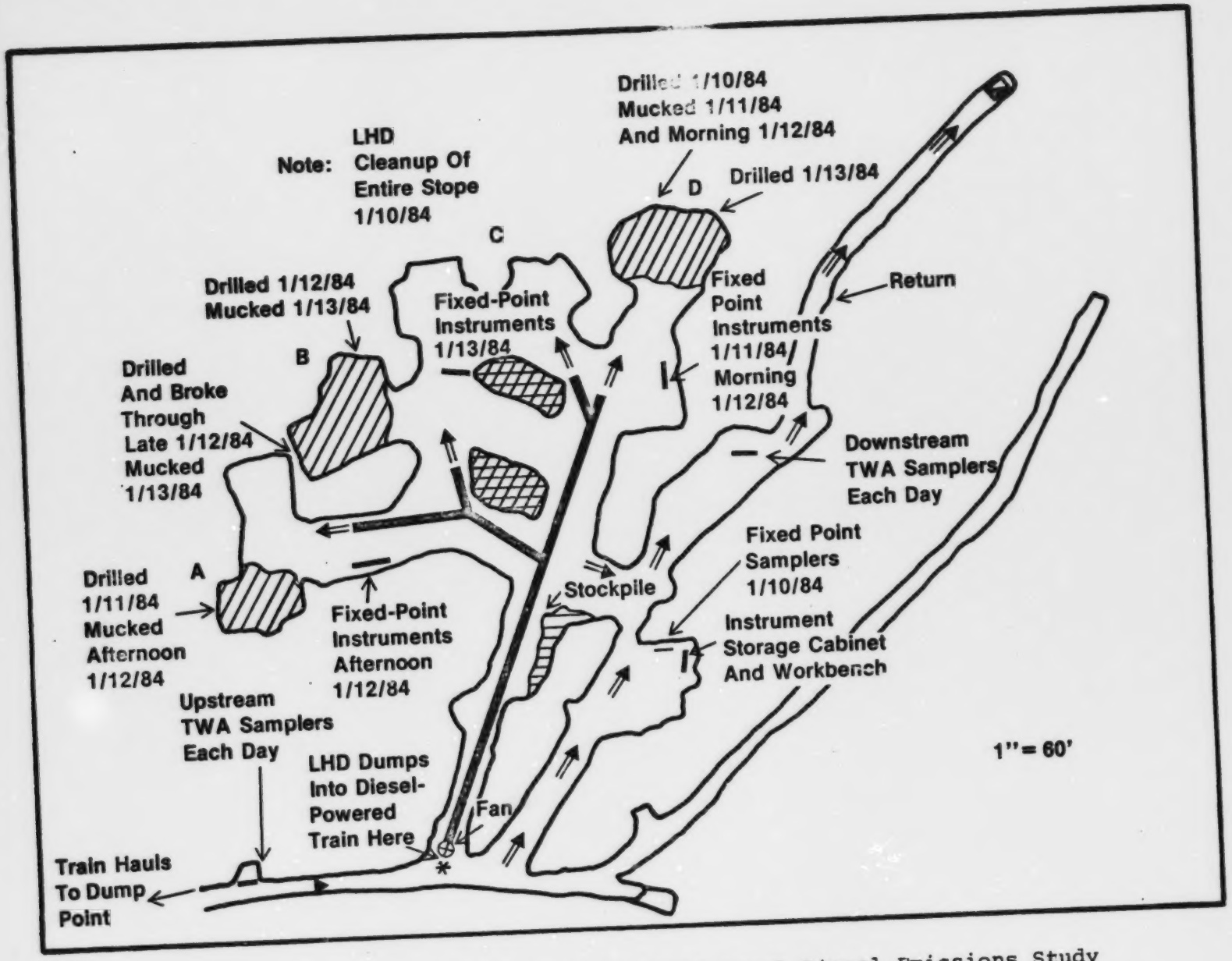

Figure 1. Little Stobie 1400 Level Diesel Emissions Study Area As It Was Week of 1/9/84

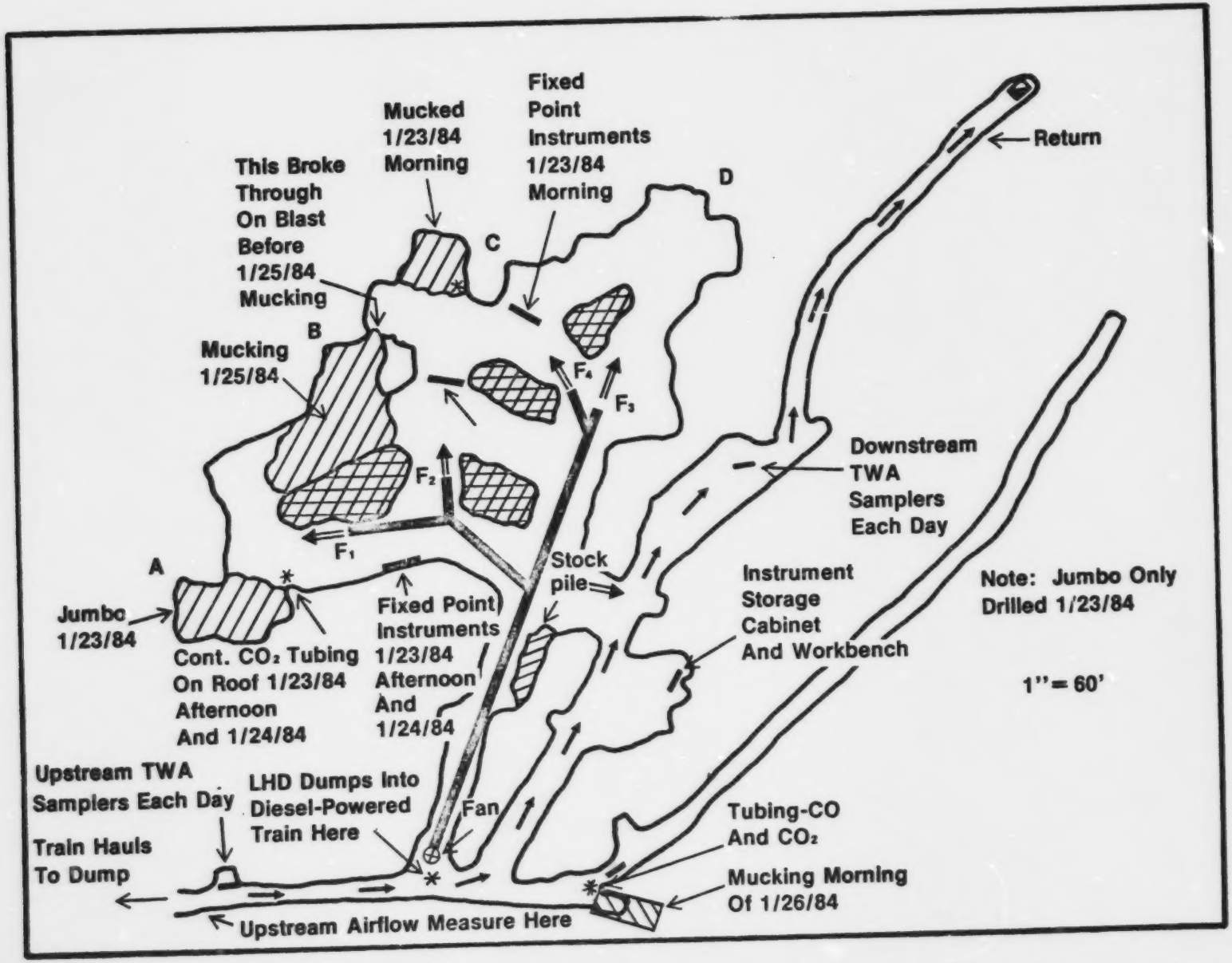

Figure 2. Little Stobie 1400 Level Diesel Emissions Study Area As It Was Week of 1/23/84

cal procedures employed. This causes limitations in the data analysis and interpretation as discussed later.

During both weeks of the study, ore was mucked from the piles as indicated in the Figures, and hauled either to the stockpile (near center of Figures) or to the train (near bottom center). Haul times varied greatly, however, and were dependent upon whether the LHD was loading the ore train (hauling the stockpiled ore to the train) which showed up in our data as long times out of the drift) or was stockpiling its load (at which time the LHD hauled ore the short distance from the heading, to the stockpile).

Fresh air entered the study area through the train haulage drift (bottom of Figures 1 and 2). Some of this air was picked up by the fan and blown through the 36-inch diameter rigid tubing into the stope (study area). Dampers in the tubing at the various junctions were either open or closed to direct the air to the desired locations. All of the air was eventually exhausted from the study area through the return (upper right).

The workbench and storage cabinet location is shown on the right side of the maps. Our electronic instruments, calibration gases, and TWA samplers were stored at this location. The bench space was used to prepare samplers and to fill out data sheets before and after each day of sampling.

The mining operation in the study area consisted of drilling, loading, blasting, mucking, hauling and bolting.

A two boom pneumatically operated drilling machine drilled holes in the face at a predetermined accurately spaced pattern.

This drill uses diesel power only to tram it from one location to another. This power is supplied by a Deutz F4L-912W 4 cylinder, engine rated at 52 HP. The engine is shut down while drilling takes place so it contributes very little to diesel pollutants in the stope.

Loading the ammonium nitrate blasting agent into the holes is accomplished with an Amex pneumatic loader. Blasting takes place mainly between shifts, but is also occasionally performed at lunch time. The one blast at lunch time during the 2-week study had no effect on our data since all samplers were turned off.

Mucking is accomplished with the 5 yard Jarvis Clark JS500 load-haul-dump machine. The LHD is powered by a 195 HP 8 cylinder Deutz F8L-714 naturally aspirated diesel engine. The ore is either hauled to a train or is stockpiled at an intermediate location.

The small 4-car ore train was pulled by an M & R diesel-powered locomotive. The locomotive was powered by a Deutz F4L-812, 48 HP engine. It idled most of the time in the intake drift between the upstream and downstream samplers, and thereby contributed a low quantity of diesel pollutants during both weeks of the study. When the train was hauling and dumping, its exhaust emissions were sampled by the upstream sampler. The LHD was by far the greatest source of diesel emissions in the study area.

Propane is combusted in the fresh air entering the mine to increase the air temperature. Our measurements revealed an unu-

sually high CO_2 concentration (.09-.12%) in the fresh air entering the study area which would normally measure near the .035%-.055% CO_2 for outside air. Propane combustion produces small quantities of other products of combustion similar to a diesel engine. Since these all show up in the upstream air, subtraction of the upstream (background) concentrations from those measured on the LHD, in the heading, and in the returns corrects the data for the products of propane combustion.

The presence of the airborne oil mist from the compressed air used to power the Jumbo drill is another source of particulate matter. The particulate data must therefore be carefully interpreted for the dates on which the Jumbo drill was used.

The ore itself also contains a small amount of carbon which is not distinguishable from diesel carbon by the elemental carbon and hydrogen analytical procedure used. This aspect was addressed by collecting and analyzing a pair of airborne particulate samples in a non-diesel area where the ore from the study area was being dumped. The corrections recommended will be discussed later.

The general approach to these measurements is outlined in Reference 2. The theoretical basis of the newly developed methodology which is discussed in detail in References 3 and 4 includes the following approach to the measurements:

1. All diesel exhaust pollutant concentrations are measured as time weighted averages simultaneously with the diesel-produced CO_2 concentration at the operators

breathing zone and at a fixed point station (background) upstream from the LHD to obtain the pollutant concentrations of the incoming air.

2. Data are analyzed by a computer program which normalizes each diesel pollutant concentration in terms of the simultaneously measured CO_2 concentration and calculates a number of parameters that are useful for interpreting the data. A correction is made for the background ambient CO_2 concentration.

Using the newly-developed coordinated approach to sampling and data analysis allows us to express diesel pollutant concentrations found in the mine air in terms of the concentrations which will occur at a given volume dilution ratio--(fresh air+ exhaust)/exhaust.

One important task performed by the above-mentioned data analysis computer program is that it plots all the diesel pollutant concentrations against the simultaneously measured diesel-produced CO_2 concentrations. We refer to such a plot as the "pollutant characteristic curve".

The time-weighted-average pollutant concentrations measured on the LHD which have been corrected by subtracting the fixed point "background" concentrations are plotted for each pollutant species. Presently we are gathering data for about four or five days of a mining operation and then determining the slope of the data by a least squares curve fit. Each point on the curve is called an "operating point" since these points move up or down

the curve depending upon the mining cycle and the ventilation conditions for that day. The magnitude of the slope of the characteristic curve is a measure of the quantity of the pollutant generated by the diesel engine. The slope can be decreased by improving the control of individual pollutants with after treatment devices or by changing the design of the engine. Poor maintenance or engine mechanical problems can also affect the slope. Maintenance effects can cause both increases and decreases in the slopes with many maintenance problems resulting in particulate increases and NO or NO_2 decreases as a result of reduced combustion temperatures. The slope of a pollutant characteristic curve is a very useful parameter because it expresses the pollutant concentration in a manner which is independent of the amount of dilution which has taken place subsequent to leaving the tailpipe. Furthermore, this slope is directly related to the quantity of the pollutant emitted per unit of fuel consumed or per unit of brake horsepower output. These factors make it possible to analyze and interpret data taken in production operations over several days where the ventilation and the mining cycle changes from day to day.

The important concept to understand is that the slope of the characteristic curve is an expression of the pollutant concentration that is characteristic of the particular vehicle under the mining load cycle conditions tested. Thus if the slope doubles, it means the particular vehicle is emitting twice as much of the particular pollutant per unit of CO_2 produced (or of fuel consumed or of output horsepower). The TLV or the assumed

ambient limits are imposed on the plot so as to graphically show the CO_2 concentration where the TLV will be exceeded and the relative position of the operating point in relation to the TLV. A characteristic curve for each pollutant or calculated index is constructed and analyzed.

Another concept that is just as important to understand is that the mine-air diesel-produced CO_2 concentration is a measure of the amount of ventilation per unit of fuel consumed or per unit of output horsepower. Thus the diesel-produced CO_2 concentration is directly related by Eq. 1 to the CFM/actual output BHP*

$$\text{CFM/BHP} = \frac{45.18 \times \text{BSFC}}{\text{Diesel-produced } CO_2, \text{ \% by Vol.}} \qquad \text{(Eq. 1)}$$

BSFC = Average brake specific fuel consumption, lb/bhp-hr [can vary from .4 - .48 with typical value of .45]

CFM = volume flow rate of air, CFM

BHP = brake horsepower produced, BHP

Thus there are now two significant reasons to measure CO_2 concentrations. One is that it provides a direct measure of the CFM/BHP and the second is that it provides data for determining the slope of the characteristic curves.

The computer program developed calculates these and other parameters which are very useful in the interpretation of the results.

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*The term "actual output BHP" is used to emphasize that the CO_2 measurement is related to the actual power being produced by the vehicle which is different than the "installed" or "rated power" of an engine.

Table 1 lists the measurements which were included in the study. As already mentioned, simultaneous time-weighted-average CO_2, CO, NO, NO_2, and total particulate matter samples were taken at each of four different locations. The TWA CO_2 and CO concentrations were measured on a sample collected in a 22-liter Calibrated Instruments 5-layer bag over the sampling period and read out at the end by accurately calibrated electronic instruments. The Fuji ZFP5 NDIR portable CO_2 monitor was used to measure CO_2 and the Ecolyzer 2106 electrochemical CO monitor with its Purafil interference filter was used to measure CO in the bag.

Palmes' samplers measured NO_2 and NO_x. These passive samplers react a quantity of NO_2 on TEA-coated screens which is proportional to the concentration of NO_2 or NO_x to which the sampler is exposed. The NO_2 concentration is calculated first and is subtracted from the simultaneously-measured NO_x concentration to arrive at the NO concentration.

Particulate matter was collected on 37-mm Gelman A/E glass fiber filters. Mine air was drawn through the filter at a flow rate of 4.75 liters/minute. The diesel portion of the "respirable combustible dust" (RCD) was determined by elemental carbon and hydrogen analysis of the filter with a Perkin Elmer model 240 Elemental Analyzer. The quantity of diesel particulate collected is assumed to be equal to the sum of the weights of carbon and hydrogen collected on a filter. A calculated sulfate fraction was also added to the carbon and hydrogen to give the total RCD and sulfate.

Table 1. Measurements Included in Study

Upstream, LHD On-Board, In Heading, Downstream

CO, CO_2 } Bag samples read out by Ecolyzer 2106 for CO and Fuji ZFP5 for CO_2

NO, NO_2 } Palmes NO_2 and NO_x samplers in triplicate

Total particulate — Pumps drawing air at aim 4.75 lpm flowrate through 37 mm Gelman A/E glass fiber filter in duplicate

SO_2, SO_4 } By calculation from CO_2 concentration, fuel sulfur analysis and assumed 10% conversion of fuel sulfur to SO_4 with catalytic convertor, 2.5% conversion of fuel sulfur to SO_4 with filter traps; remainder to SO_2 for both systems

Additional in-Heading Measurements

Continuous Instruments -

CO - Ecolyzer 2106 - Heading variability
NO - Ecolyzer 7921 } For comparison
NO_2 - Ecolyzer 7921 } with Palmes' samplers.
CO_2 - Fuji ZFP5 on roof for load-haul-dump cycle variability assessment

Other Measurements

Mode times
Air flows - upstream, downstream and tubing outlets

Temperatures - Upstream, downstream and heading

Fuel Sulfur

The SO_2 concentration was calculated from the CO_2 concentration, the fuel sulfur concentration and the assumption that all of the fuel sulfur is combusted. For exhaust which is passed through the LHD PTX catalytic converter, 90% of the fuel sulfur is assumed to be combusted to SO_2 and 10% to SO_4. For exhaust passed through the particulate trap, 97.5% of the fuel sulfur is assumed to be combusted to SO_2 and 2.5% to SO_4.

CO was measured continuously at the heading fixed-point sampling location. Such continuous CO traces, as mentioned above, were used to determine if blast-related CO escaping from the muck pile had a significant effect on the measurements. The continuous CO traces were also used to reveal any greater than normal CO concentrations as a result of burn-off of the particulate in the ceramic trap.

CO_2 was measured continuously on the roof as near as possible to the heading being mucked to assess the load-haul-dump cycle concentration variations. These measurements were made to shed light on the ventilation in terms of how it affects the rate at which the mucking area is purged of diesel emissions.

NO and NO_2 were measured continuously near the Palmes' samplers at the heading fixed-point sampling location with the Ecolyzer 7921 electrochemical NO-NO_2 analyzer using the manufacturers recommended interference filters on the inlets to both electrochemical cells. These measurements were made to compare with the Palmes' sampler NO and NO_2 measurements to assess the Palmes' sampler accuracy.

MINE AIR QUALITY DATA

Appendix 1 contains maps which show the relative positions of the headings mucked on each of the 8 days of the study. The various situations were quite similar -- there were no long headings. We wouldn't expect significant concentration variations based on the shapes of these areas.

Table 2 lists the conditions for each of the 8 days. The intake airflow was relatively constant throughout the study, but the tubing airflows were changed daily to direct fresh air into the areas being mucked. The percentages of time the LHD spent in the heading indicate that on some days the LHD did not operate for considerable periods of time. Variations such as those caused by stopping the LHD would be expected to dilute the LHD-generated pollutant concentrations similar to a ventilation system change which increases dilution air. All the LHD-generated pollutants and CO_2 are diluted or concentrated simultaneously by stopping the vehicle operation, and therefore using the slopes of the characterstic curves eliminates the effects of such dilution and/or concentration changes. Only a change which affects the quantity of a pollutant without having a similar effect on the CO_2 concentration will affect the CO_2 - normalized data. The addition of a particulate trap is one such change in that it should reduce particulate, but not the CO_2 concentration for the same dilution and load cycle.

Using this data analysis methodology, we assume that load-cycle differences are "averaged out" by taking data over a 4 day period with each emissions control system.

Table 2 - Mine Conditions During Study

Date	LHD No.	Exhaust system	Median Time In mode, sec				Total median cycle time, sec	Avg. cycle Time, sec	% of time in mode 2	% of time in modes 1-3	% of time operating (med x 100/avg)
			1	2	3	4					
1/10/84	1	Catalyst	12	29	13	94	148	216	19.6	36.4	68.6
1/11/84	1	Catalyst	13.5	26	15	91	146	270	17.8	37.3	53.8
1/12/84	1	Catalyst	24	26.5	23	102	175	221	15.1	42.0	79.3
1/13/84	1	Catalyst	14	29	13	75.5	132	189	22.0	42.4	69.7
1/23/84	1	Filter	11	24	12	106	152	268	15.8	35.1	57.0
1/24/84	1	Filter	23	24	22.5	62	132	145	18.2	52.6	90.8
1/25/84	1	Filter	20	19	19	83	141	164	13.5	41.1	85.7
1/26/84	1	Filter	12	30.5	11	101	154	255	19.8	34.7	60.6

Date	AIRFLOWS, CFM						TEMPERATURES, °C		
	Up-Stream	Down-Stream	Tubing outlet				Up-Stream	Down-Stream	Heading
			F1	F2	F3	F4			
1/10/84	36,000	36,000			22,000		5.50	11.00	
	34,000	36,000					5.75	10.50	
1/11/84	33,000	35,000			22,000		4.50	11.00	
	34,000	34,000					4.50	11.00	
1/12/84	33,000	32,000	17,200		21,500*		4.50	10.50	
	32,000	33,000					5.50	11.00	
1/13/84	33,000	33,000	12,200	8,900			5.50	9.50	
			12,000	9,000					
1/23/84	37,000	38,000	11,100	8,300			5.50	10.50	12.00
	37,000	36,000	8,500	8,500			6.75	10.25	
1/24/84	38,000	36,000	16,700				7.75	11.00	13.00
	Low**	Low**	17,100				8.50	11.50	14.00
1/25/84	38,000	36,000	11,100	8,500			8.00	11.75	12.00
	37,000	36,000		8,600			7.75	12.00	12.00
1/26/84	36,000	36,000					6.75	9.50	7.50

* Measured in morning - a change may have occurred at noon.
** Low: Flow was too low to be measured with the anemometer.

Our inspection of the CO strip charts taken at the heading fixed point TWA sampler location revealed no evidence of CO variability. Thus it was concluded that significant quantities were not left in the muck pile nor were significant quantities generated by particulate burn off in the traps while mucking. However, we are unable to conclude that such burn-off is not a problem since it is thought that the particulate collected by the traps will not ignite until there is a considerably greater buildup than that which would have taken place in our one week study (the traps were installed Saturday, January 21 and our tests were completed Thursday, January 26, 1984). Checks made by CANMET personnel during the week revealed little, if any, increase in back pressure which would be associated with particulate matter buildup.

The continuous NO and NO_2 measurements by the Ecolyzer 7021 at the heading fixed-point TWA sampler location were analyzed and compared with the Palmes' samplers. The NO_2 calibration gases were found to have changed and the change is thought to be due to low temperatures encountered during highway tansportation from CANMET and MTU laboratories to Sudbury. Thus, while the Ecolyzer NO_2 measurements were corrected to account for the calibration gas concentration changes, the corrected readings were abnormally low relative to the Palmes' samplers. This resulted in lower characteristic curve slopes for NC and NO_2 than we have seen to date. Although we were unable to explain the large differences recorded, we decided that it would not be justifiable to apply instrument correction factors to the Palmes' sampler data.

Strip charts of CO_2 concentrations vs time on the roof were kept. The peak heights on these charts are indicative of the amount of ventilation in the mucking area as is the rate at which the concentration drops off while the LHD is hauling. Under constant loader duty cycle conditions, higher peaks are indicative of less ventilation and quicker drop off is associated with more ventilation. Interpretation of these data is easiest when headings have well-defined geometries and repeatable measurement situations are present. The impact of heading geometry and ventilation on the on-board measurements is most important where headings are long and haul distances are short resulting in the LHD spending a large percentage of its operating time in the heading.

The Little Stobie study area was characterized by very short irregular headings and long haul times. Furthermore, as mentioned earlier, the LHD exhaust was emitted in the open stope during mucking and not in side-pockets that have the characteristics of dead end drifts. Also, the volume/direction of air passing over the mucking location could not be accurately described. For the above reasons, no effort was made to interpret the fixed-point CO_2 strip charts for this report.

Measurements on-board represent the complete range of LHD engine load and speed conditions, and the concentrations are those to which the LHD-operator is exposed.

Fixed-point mucking area measurements were made because it was thought that the particulate samples would be largely free of the drill oil mist. Fans and tubing direct drill oil free

upstream air toward the headings and this air would be expected to return from the heading containing only diesel emissions (not drill oil). Thus the TWA samplers located near the heading should be exposed mainly to diesel emissions since the drill oil produced in other headings would not be expected to reach these samplers. LHD and downstream particulate samplers, on the other hand, would be expected to sample this drill oil mist. The downstream concentrations can be related to flow measurements in the intake and return air streams.

The earlier-mentioned particulate samples which we collected in the non-diesel area where the ore from our study area was dumped were found to contain about 8.5% carbon + hydrogen. If we assume the ore dust fraction of the particulate matter collected in our study area also contained this percentage of carbon + hydrogen, we can estimate the percentage of the carbon plus hydrogen that does not originate from the ore (that which is generated by the diesel or drill oil particulate).

Figure 3 is a graph showing the approximate relationship between the percentage of the particulate collected on a filter that is carbon + hydrogen and the percentage of this carbon + hydrogen that is from sources other than the ore itself. The graph indicates that for our LHD particulate samples which were typically 25 to 50% carbon + hydrogen, the RCD would be 75 to 90% of diesel or drill oil origin with 10-25% from the C+H in the ore itself. Thus if the ore fraction of the particulate in our study area contains this average 8.5% C+H, the RCD reported, which also contains the diesel exhaust/oil mist, is an overestimate of the diesel fraction by 11-33%.

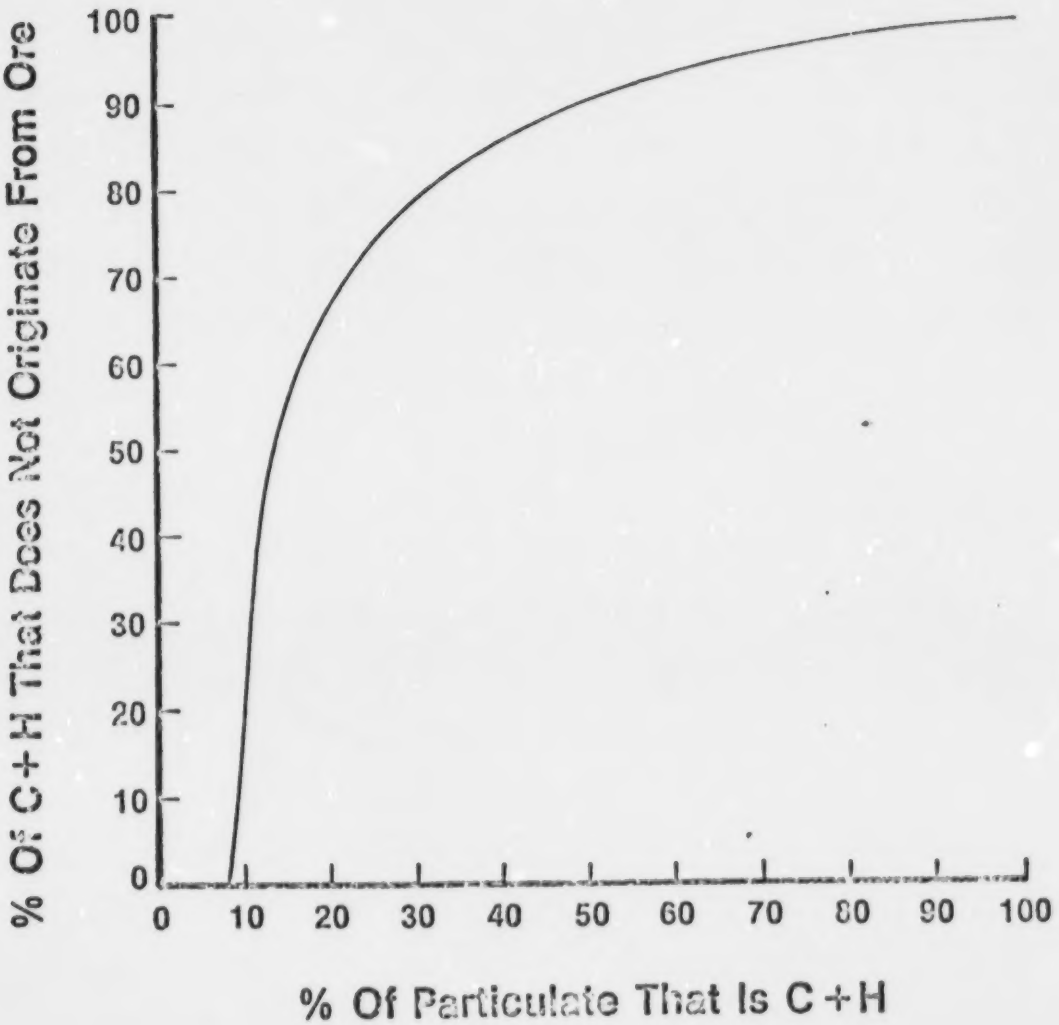

Figure 3. Graph showing approximate relationship between % of particulate that is C + H and % of C + H that does not originate from the ore itself (ore found to contain 8.5% C + H)

Measurement data from all three locations were analyzed by the computer program which subtracted the upstream values and normalized the pollutant concentrations by expressing them as slopes of the pollutant vs CO_2 characteristic curves. All the analyzed data are presented in Appendix 2. Only the LHD on-board data are discussed here to illustrate the methodology. A more complete understanding of the effects of the ceramic filter on the mine air quality will require additional study of the measurements made in the heading and those made downstream.

The data analysis makes use of the Air Quality Index (AQI) which is calculated as follows:

$$AQI = \frac{CO}{50} + \frac{NO}{25} + \frac{RCD}{2} + 1.5\left[\frac{SO_2}{3} + \frac{RCD}{2}\right]^{*} + 1.2\left[\frac{NO_2}{3} + \frac{RCD}{2}\right]^{**} \qquad \text{(Eq. 2)}$$

where

AQI = Air Quality Index
CO = CO concentration, ppm
NO = NO concentration, ppm
RCD = Respirable combustibe dust (particulate)*** concentration & sulfate, mg/m^3
SO_2 = SO_2 concentration, ppm
NO_2 = NO_2 concentration, ppm

* If SO_2 = 0, the complete bracketed term should be set equal to zero.
** If NO_2 = 0, the complete bracketed term should be set equal to zero.

***Respirable combustible dust is what is measured by the procedures developed at MTU for estimating the percentage of respirable particulate matter based on the carbon and hydrogen in the particulate sample on the filter.

Table 3 presents the on-board LHD pollutant concentrations and Table 4 presents the upstream concentrations that were measured on the same dates over roughly the same time periods.

Table 3

Date Monitored	CO_2, % - .035	CO, ppm	NO, ppm	NO_2, ppm	SO_4, mg/m^3	SO_2, ppm	TPM, mg/m^3	RCD, mg/m^3	TPM-RCD, mg/m^3	AQI
LHD POLLUTANT CONCENTRATION										
Week 1 - Catalytic Convertors										
1-10-84	0.16	3.30	5.40	0.71	0.29	0.61	2.83	1.46	1.38	4.11
1-11-84	0.15	2.00	5.57	0.93	0.22	0.48	1.75	0.76	0.98	2.69
1-12-84	0.16	3.00	7.43	0.81	0.27	0.58	2.73	1.29	1.44	3.86
1-13-84	0.15	3.40	4.11	1.26	0.21	0.44	1.55	0.78	0.77	2.79
Avg.	0.15	2.92	5.63	0.93	0.25	0.53	2.22	1.07	1.14	3.36
Week 2 - Ceramic Traps										
1-23-84	0.14	3.50	5.17	0.95	0.08	0.76	1.71	0.80	0.91	2.68
1-24-84	0.13	3.60	6.97	0.93	0.07	0.68	1.89	0.61	1.28	2.32
1-25-84 & 1-26-84 combined	0.12	2.61	3.63	1.39	0.06	0.52	1.85	0.57	1.28	2.17
Avg.	0.13	3.24	5.26	1.09	0.07	0.65	1.82	0.66	1.16	2.39

Table 4

Date Monitored	CO_2, % - .035	CO, ppm	NO, ppm	NO_2, ppm	SO_4, mg/m^3	SO_2, ppm	TPM, mg/m^3	RCD, mg/m^3	TPM-RCD, mg/m^3	AQI
UPSTREAM POLLUTANT CONCENTRATION										
Week 1 - Catalytic Convertors										
1-10-84	0.08	2.80	0.19	0.53	0.0	0.0	0.00	0.04	-0.04	0.32
1-11-84	0.08	1.30	0.30	0.55	0.0	0.0	0.07	0.05	0.03	0.31
1-12-84	0.08	2.00	0.46	0.40	0.0	0.0	0.10	0.08	0.02	0.30
1-13-84	0.09	1.60	0.59	0.39	0.0	0.0	0.04	0.06	-0.01	0.28
Avg.	0.08	1.92	0.38	0.47	0.0	0.0	0.05	0.06	-0.00	0.30
Week 2 - Ceramic Traps										
1-23-84	0.06	2.00	0.42	0.34	0.0	0.0	0.20	0.02	0.18	0.22
1-24-84	0.06	2.00	0.32	0.60	0.0	0.0	0.17	0.06	0.11	0.36
1-25-84 & 1-26-84 combined	0.07	1.27	0.95	0.57	0.0	0.0	0.14	0.06	0.08	0.36
Avg.	0.06	1.76	0.57	0.50	0.0	0.0	0.17	0.05	0.13	0.31

We subtracted the upstream concentrations from those measured on-board to arrive at the LHD effect referred to here as 'LHD-Upstream'.

LHD-Upstream pollutant concentrations are presented in Table 5. Figures 4-15 show the operating points for these data and the least squares curve fit characteristic curves. Table 6 presents the slopes of the characteristic curves.

Table 7 expresses the LHD-Upstream operating concentrations as percentages of the assumed limits; none exceeds 100%. The AQI at 4 is seen to be the most stringent limit to meet with respect to the measured concentrations, and RCD at an assumed limit of 2 mg/m^3 is next.

Table 8 presents arithmetic averages only for the LHD-Upstream concentration data. This table also includes averages for other useful parameters by which to compare the two exhaust systems. The LHD-Upstream CO slope is apparently slightly higher for the ceramic traps, but still at a low acceptable level. The differences for SO_4 and SO_2 are calculated values which are based on the assumptions discussed earlier that more SO_4 is formed with the catalytic convertor than with the traps. The measured total particulate matter (TPM), RCD and RCD+SO_4 slopes are all lower for the ceramic traps as would be expected. The slope of the characteristic curve is decreased 43% for RCD+SO_4 (Figs. 8 & 14) and 28% for the AQI (Figs. 9 & 15). If the two weeks were compared on the basis of the same fuel sulfur content (.19% which equals first week content) the RCD+SO_4 decrease due to the traps would be 44% and the AQI decrease due to the traps would be 31%.

Table 5

LHD-UPSTREAM POLLUTANT CONCENTRATION

Date Monitored	CO_2, %	CO, ppm	NO, ppm	NO_2, ppm	SO_4, mg/m^3	SO_2, ppm	TPH, mg/m^3	RCD, mg/m^3	TPH-RCD mg/m^3	AQI
Week 1 - Catalytic Convertors										
1-10-84	0.08	0.50	5.22	0.19	0.29	0.61	2.83	1.42	1.42	3.75
1-11-84	0.06	0.70	5.27	0.38	0.22	0.48	1.67	0.72	0.96	2.36
1-12-84	0.08	1.00	6.98	0.41	0.27	0.58	2.64	1.21	1.42	3.50
1-13-84	0.06	1.80	3.52	0.87	0.21	0.44	1.50	0.72	0.78	2.46
Avg.	0.07	1.00	5.24	0.46	0.25	0.53	2.16	1.02	1.15	3.02
Week 2 - Ceramic Traps										
1-23-84	0.08	1.50	4.75	0.60	0.08	0.76	1.51	0.78	0.73	2.44
1-24-84	0.07	1.60	6.66	0.34	0.07	0.68	1.72	0.55	1.17	1.92
1-25-84 & 1-26-84 combined	0.05	1.34	2.67	0.82	0.06	0.52	1.72	0.51	1.20	1.77
Avg.	0.07	1.48	4.69	0.59	0.07	0.65	1.65	0.61	1.03	2.04

Table 6

LHD-UPSTREAM SLOPES OF POLLUTANT CHARACTERISTIC CURVES

	CO, ppm/%	NO, ppm/%	NO_2, ppm/%	SO_4, mg/m^3 /%	SO_2, ppm/%	TPH, mg/m^3 /%	RCD, mg/m^3 /%	TPH-RCD, mg/m^3 /%	AQI/%
1-10-84	6.17	64.38	2.31	3.56	7.57	34.96	17.48	17.48	46.34
1-11-84	11.11	83.63	6.03	3.56	7.57	26.57	11.38	15.19	37.41
1-12-84	13.16	91.79	5.45	3.56	7.57	34.70	15.96	18.74	46.01
1-13-84	31.03	60.69	14.93	3.56	7.57	25.93	12.41	13.52	42.36
Avg.	14.39	75.47	6.64	3.56	7.57	31.10	14.63	16.48	43.40
1-23-84	19.48	61.73	7.84	1.08	9.93	19.57	10.12	9.45	31.67
1-24-84	23.53	97.90	4.96	1.08	9.93	25.29	8.09	17.21	28.29
1-25-84 & 1-26-84 combined	25.87	51.35	15.71	1.08	9.93	33.00	9.87	23.13	34.06
Avg.	22.56	71.47	8.92	1.08	9.93	25.09	9.35	15.74	31.14

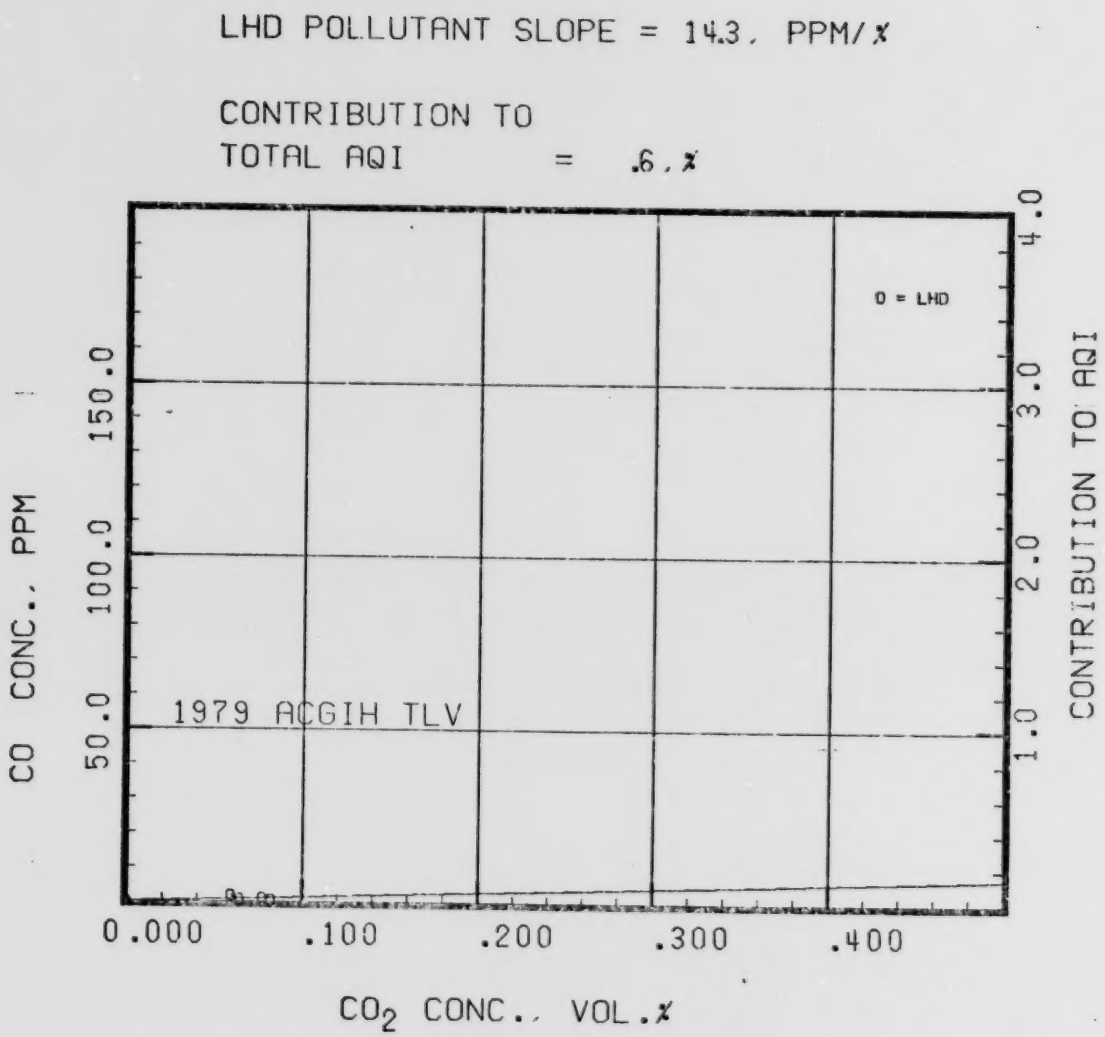

Figure 4. CO characteristic curve. PTX catalytic convertors (January 9-13, 1984)

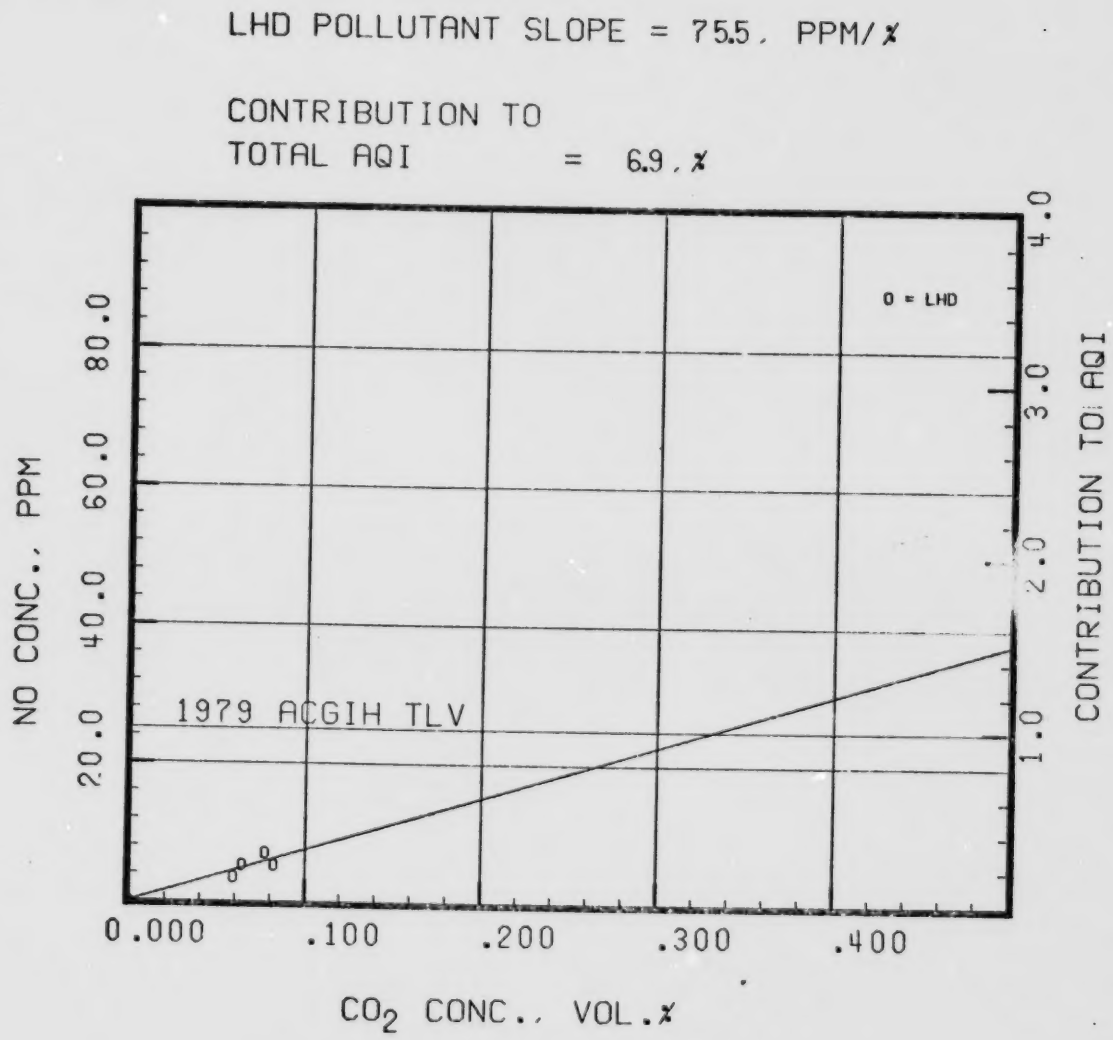

Figure 5. NO characteristic curve. PTX catalytic convertors (January 9-13, 1984)

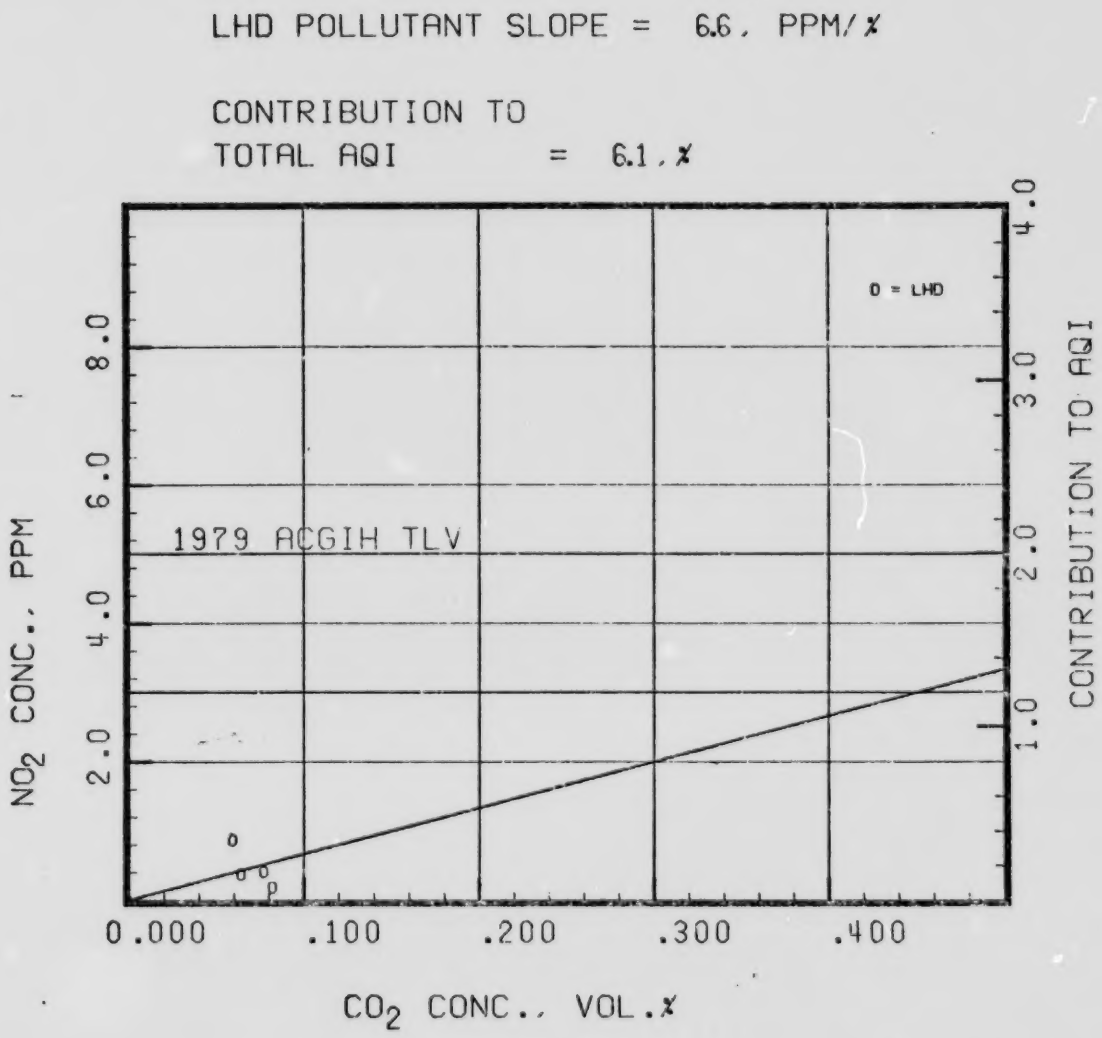

Figure 6. NO_2 characteristic curve. PTX catalytic convertors (January 9-13, 1984)

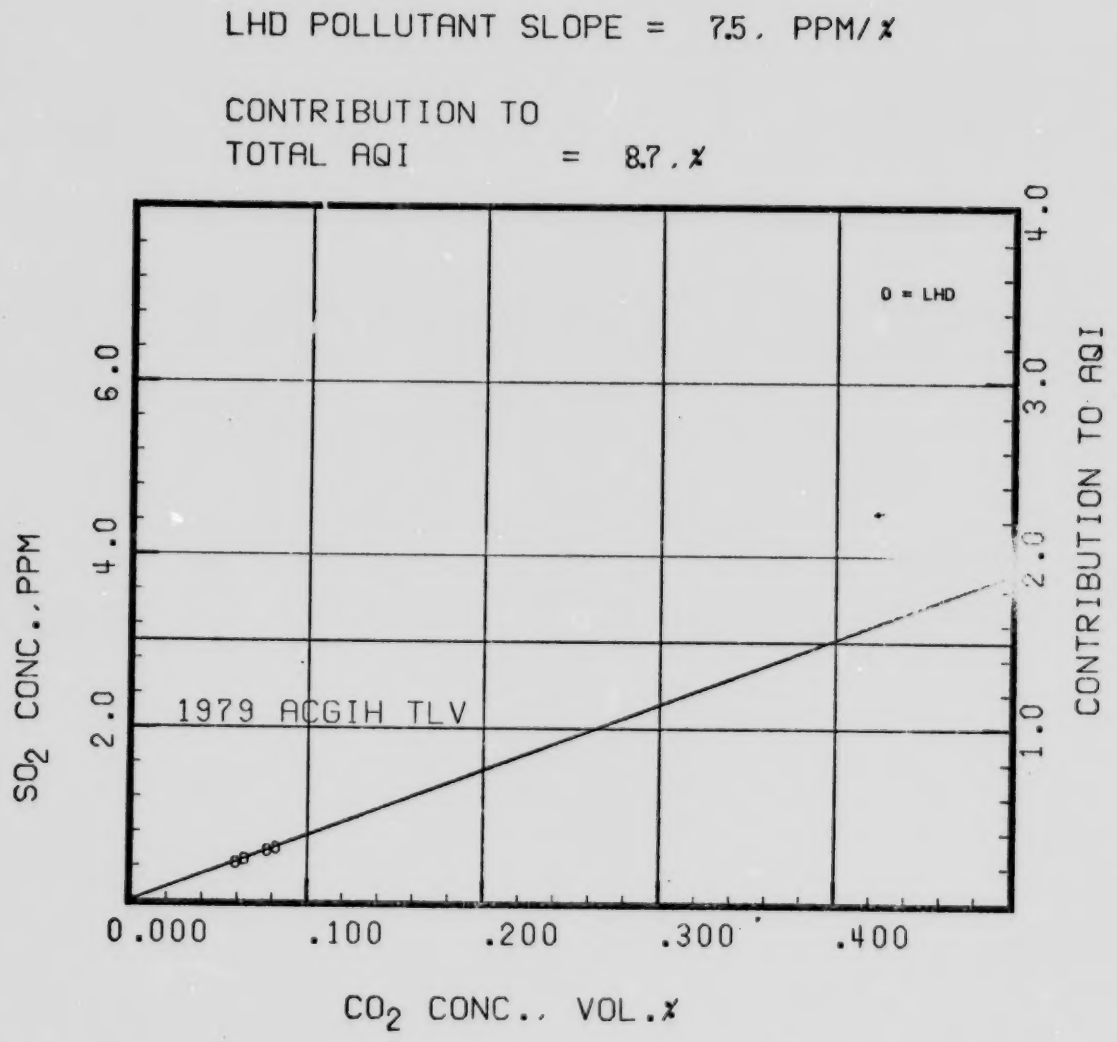

Figure 7. SO_2 characteristic curve. PTX catalytic convertors (January 9-13, 1984) fuel sulfurs 0.19% by mass.

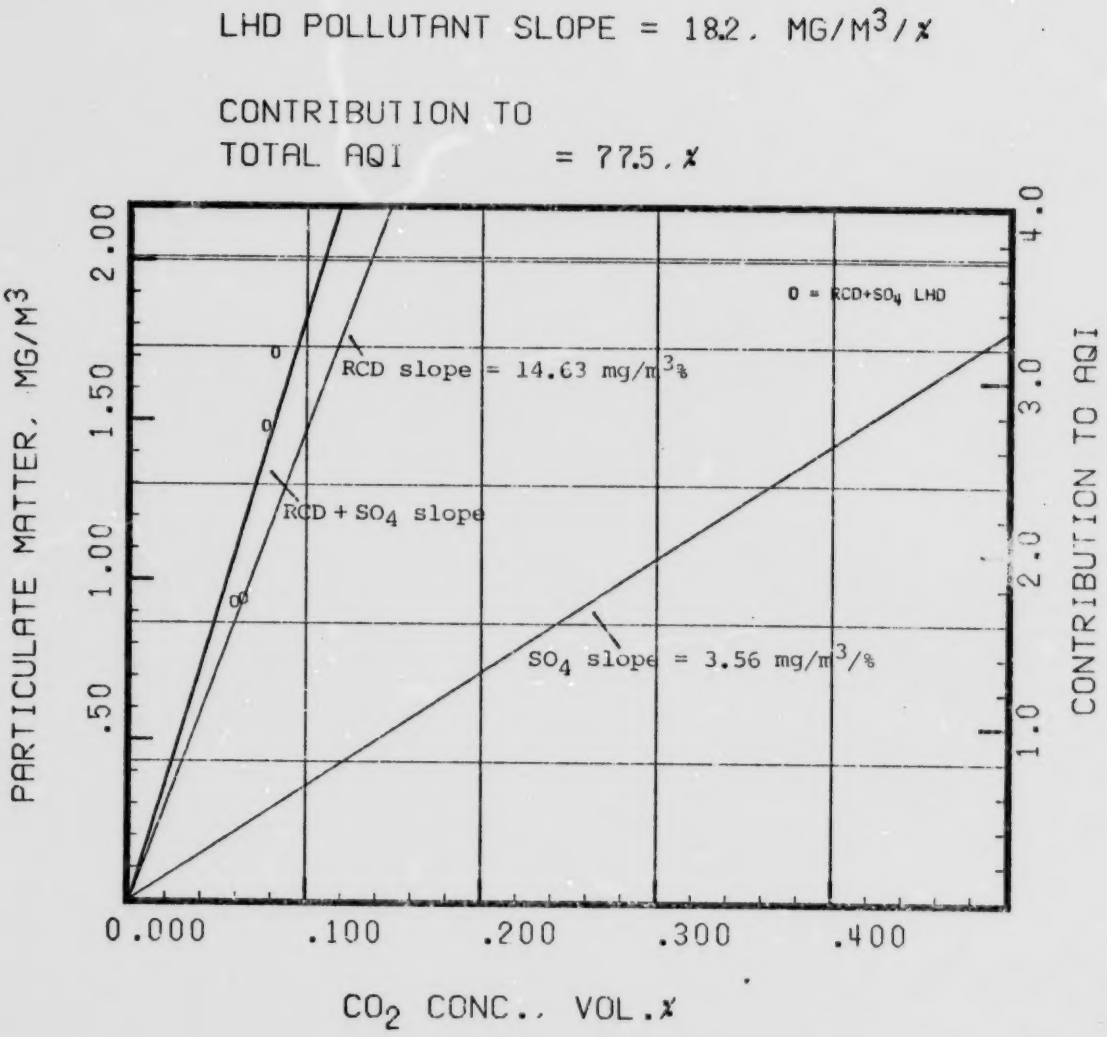

Figure 8. Particulate matter characteristic curve. PTX catalytic convertor (January 9-13, 1984).

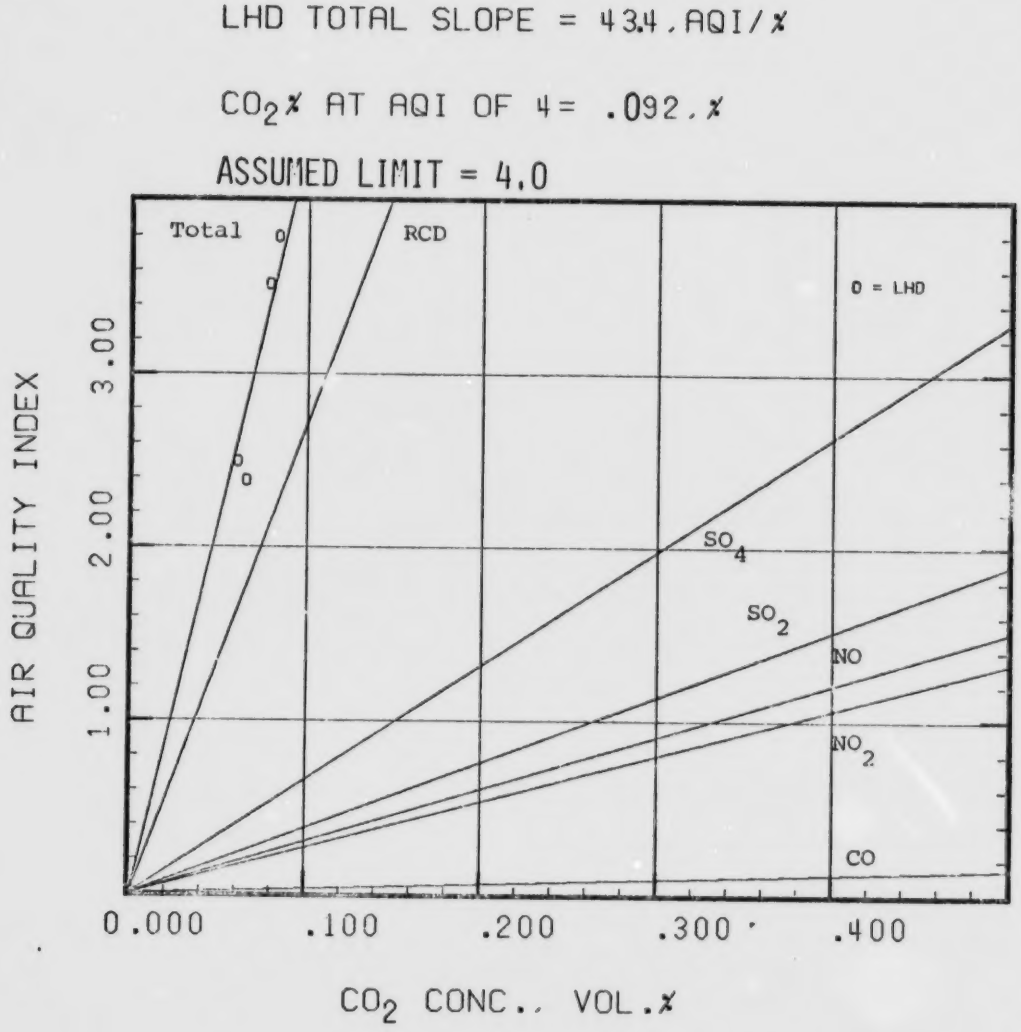

Figure 9. AQI vs. CO_2 concentration. PTX catalytic convertors (January 9-13, 1984).

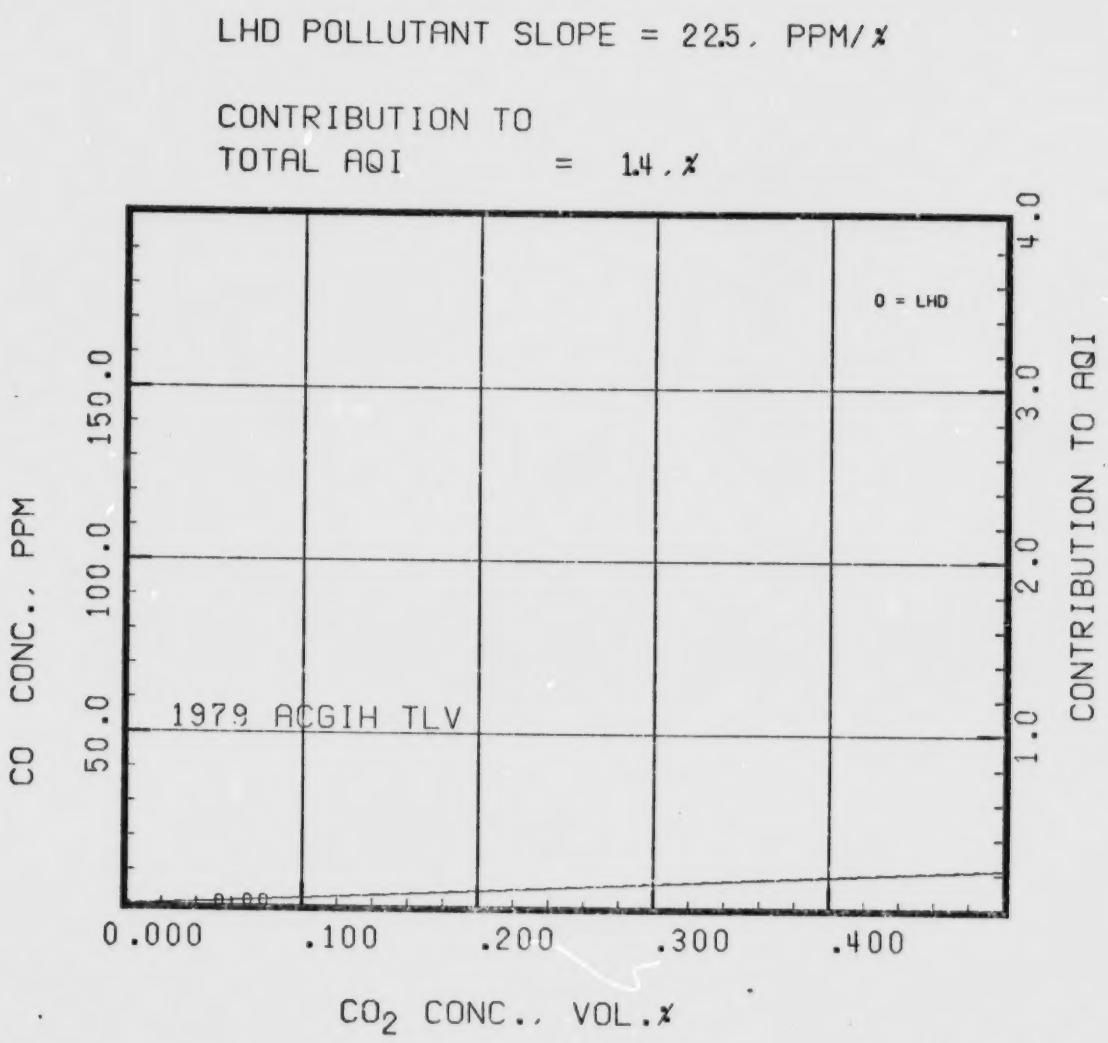

Figure 10. CO characteristic curve. Corning traps (January 23-26, 1984)

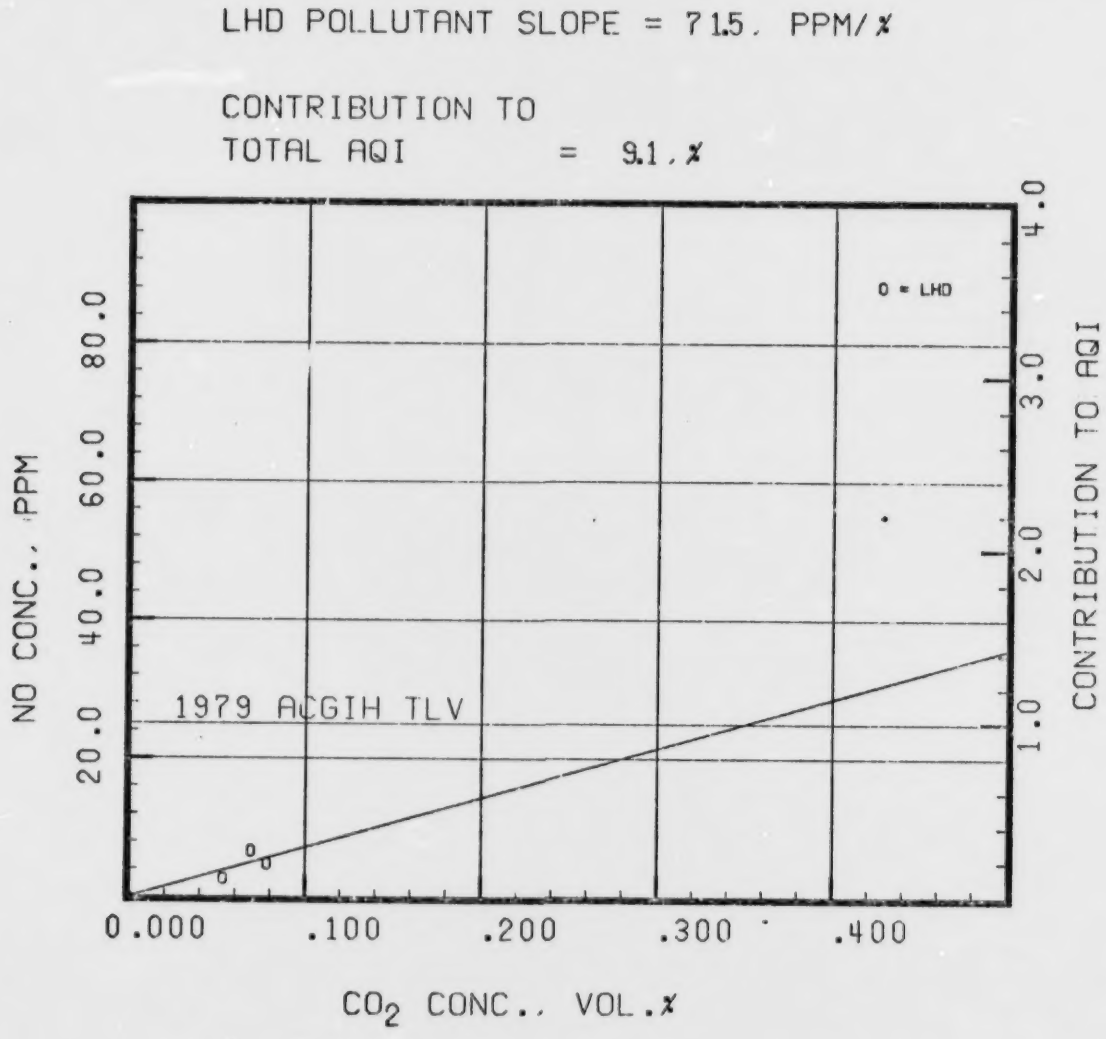

Figure 11. NO characteristic curve. Corning traps (January 23-26, 1984)

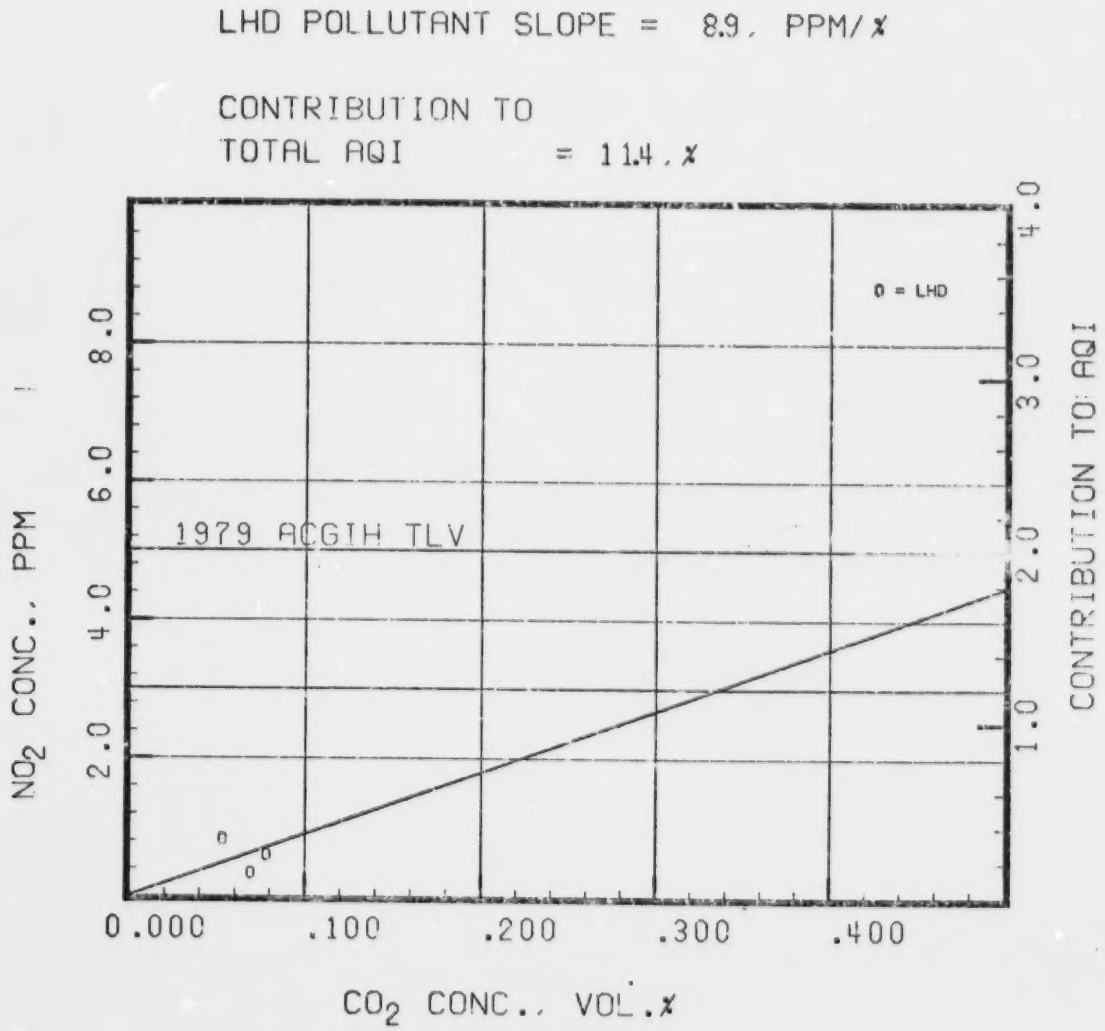

Figure 12. NO_2 characteristic curve. Corning traps (January 23-26, 1984)

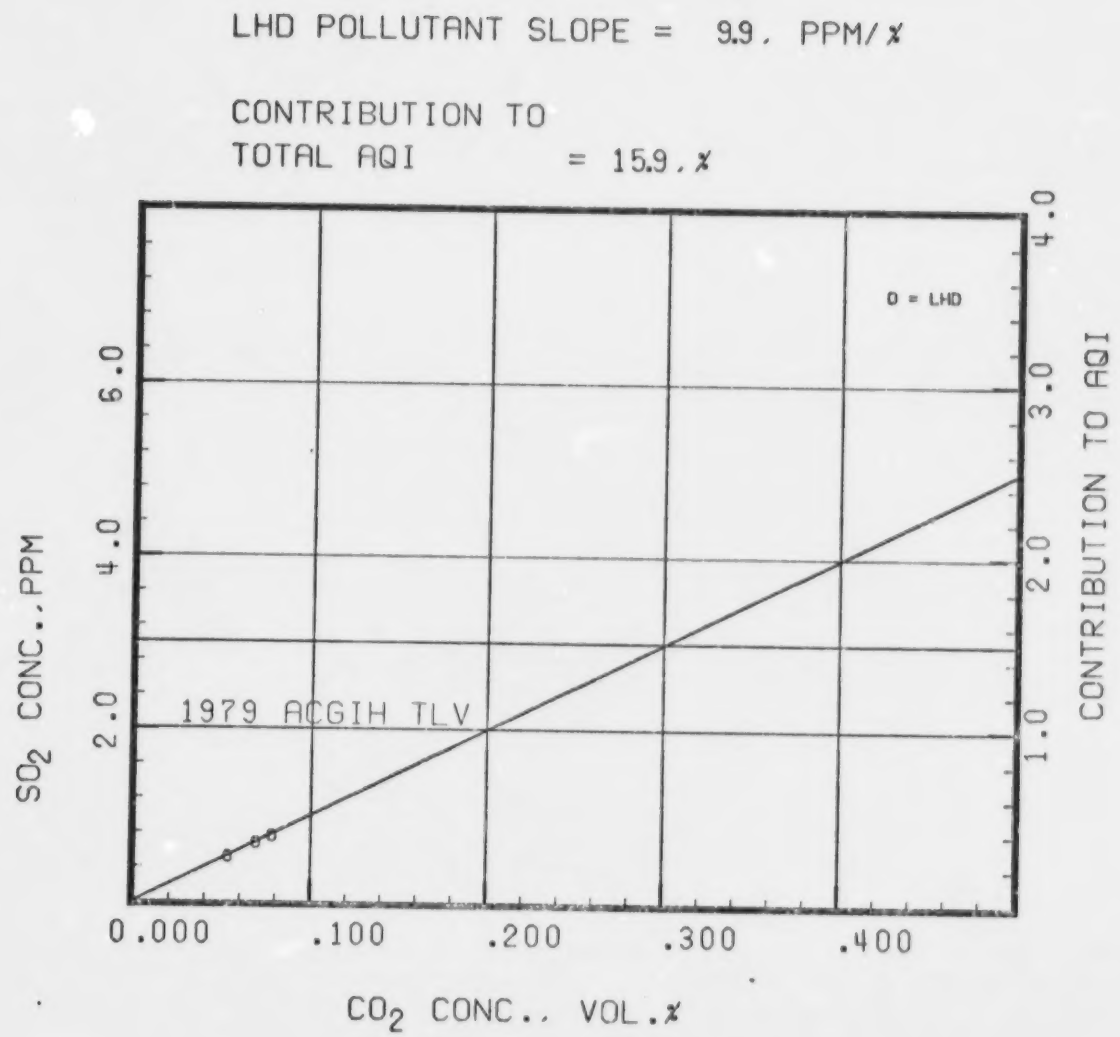

Figure 13. SO_2 characteristic curve. Corning traps (January 23-26, 1984)

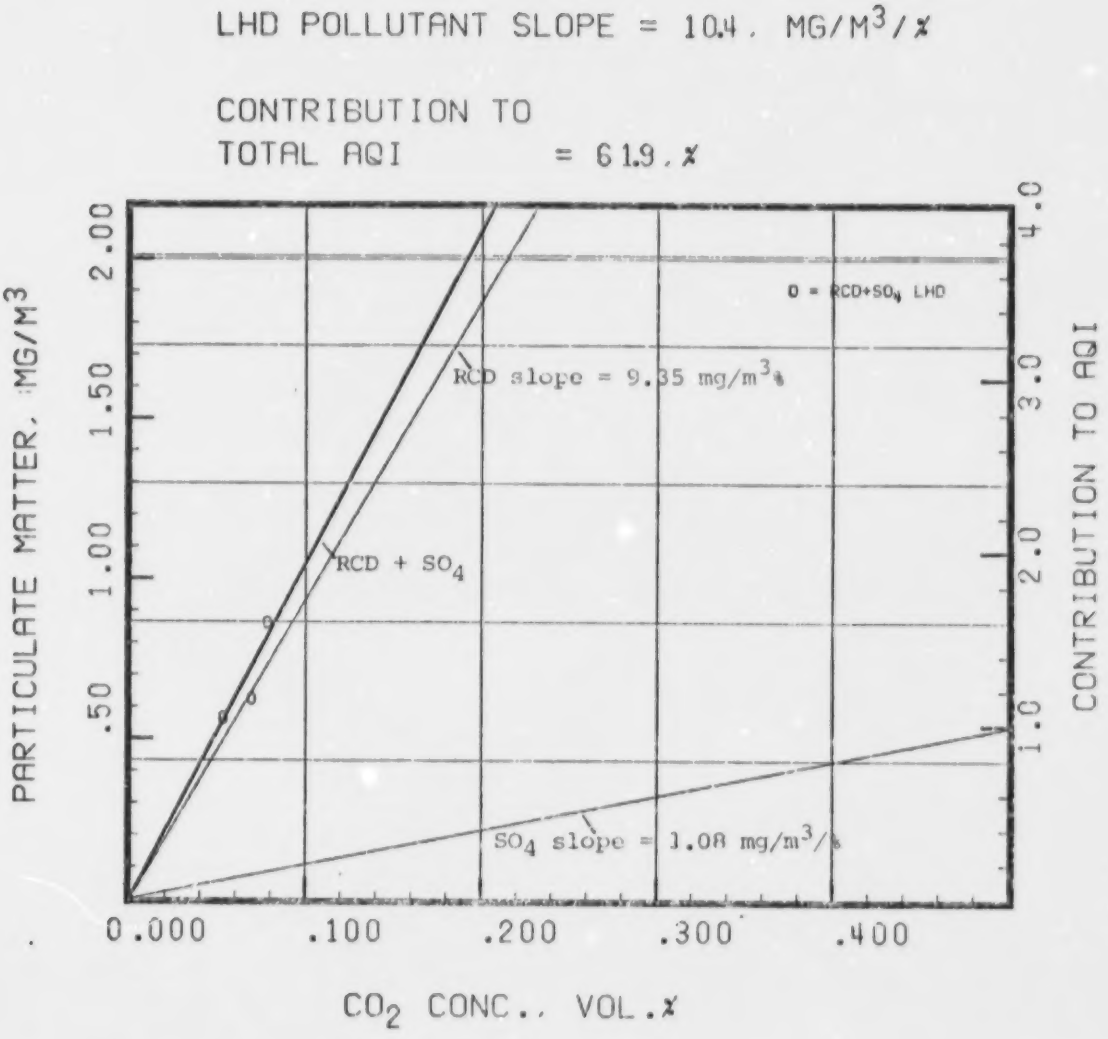

Figure 14. Particulate matter curve. Corning traps (January 23-26, 1984).

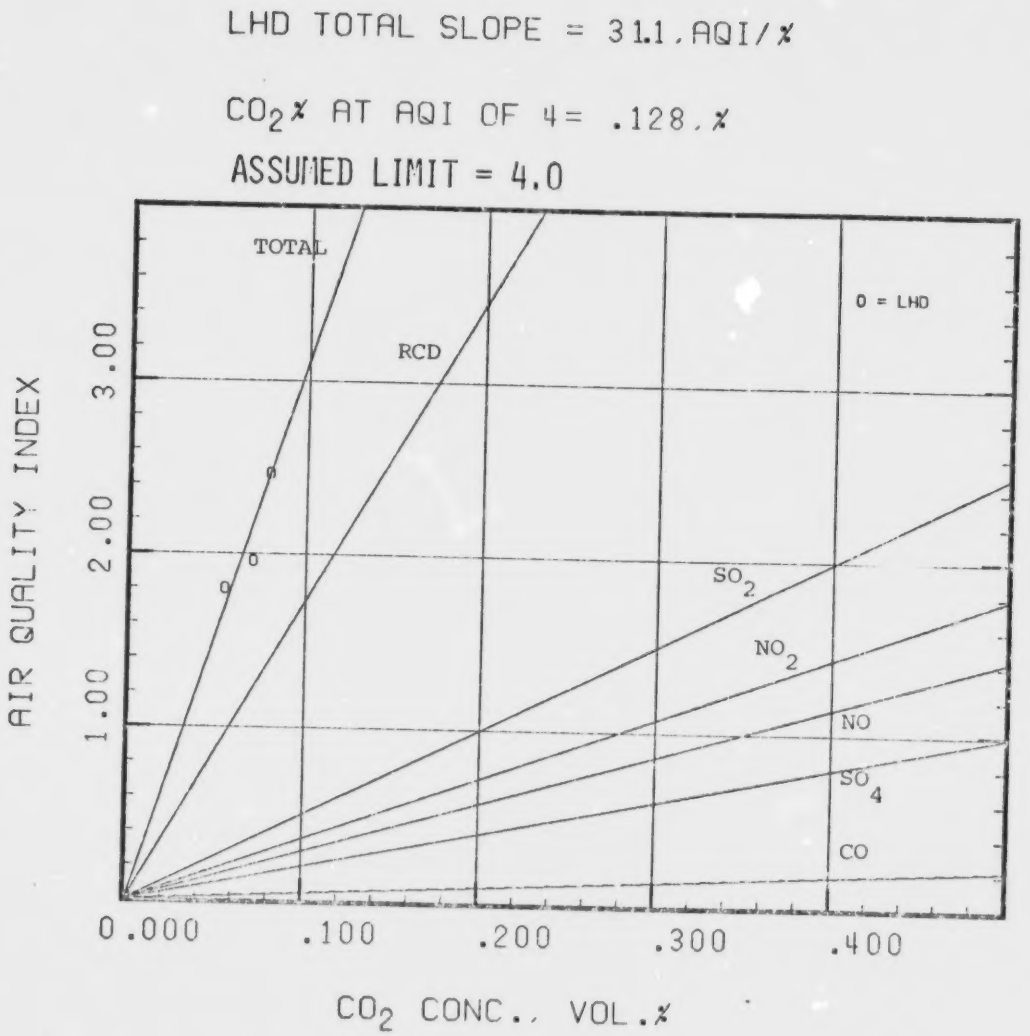

Figure 15. AQI vs. CO_2 concentration. Corning traps. (January 23-26, 1984).

Table 7

LHD-Upstream Operating Concentration, % of Assumed Limit*

Date Monitored	CO, %	NO, %	NO_2, %	SO_4, %	SO_2, %	TPM, %	RCD, %	AQI, %
1-10-84	1.0	20.9	3.7	28.9	30.7	56.6	70.8	93.8
1-11-84	1.4	21.1	7.6	22.4	23.8	33.5	35.8	58.9
1-12-84	2.0	27.9	8.3	27.1	28.8	52.7	60.6	87.4
1-13-84	3.6	14.1	17.3	20.7	22.0	30.1	36.0	61.4
Avg.	2.0	21.0	9.2	24.8	26.3	43.2	50.8	75.4
1-23-84	3.0	19.0	12.1	8.3	38.2	30.1	38.9	61.0
1-24-84	3.2	26.6	6.7	7.3	33.8	34.4	27.5	48.1
1-25-84 & 1-26-84 combined	2.7	10.7	16.3	5.6	25.8	34.3	25.6	44.3
Avg.	3.0	18.8	11.7	7.1	32.6	33.0	30.7	51.1

* Assumed Limit

CO = 50 ppm
NO = 25 ppm
NO_2 = 5 ppm
SO_4 = 1 mg/m^3
SO_2 = 2 ppm
TPM = 5 mg/m^3
RCD = 2 mg/m^3
AQI = 4

Table 8

LHD-Upstream Concentrations

Study Week	Exhaust System	CO_2, %	CO, ppm	NO, ppm	NO_2, ppm	SO_4, mg/m^3	SO_2, ppm	TPM, mg/m^3	RCD, mg/m^3	TPM-RCD mg/m^3	AQI
1	Catalyst	0.07	1.00	5.24	0.46	0.25	0.53	2.16	1.02	1.15	3.02
2	Ceramic Traps	0.07	1.48	4.69	0.59	0.07	0.65	1.65	0.61	1.03	2.04

LHD-Upstream Operating Concentration as % of Assumed Limit

Study Week	Exhaust System	CO, %	NO, %	NO_2, %	SO_4, %	SO_2, %	TPM, %	RCD, %	AQI, %		
1	Catalyst	2.0	21.0	9.2	24.8	26.3	43.2	30.8	75.4		
2	Ceramic Traps	3.0	18.8	11.7	7.1	32.6	33.0	30.7	51.1		

Desired Control Efficiency with CO_2 Limiting, %

Study Week	Exhaust System	CO	NO	NO_2	SO_4	SO_2	TPM	RCD	AQI		
1	Catalyst	-736	20	-81	32	36	61	67	78		
2	Ceramic Traps	-407	20	-28	-112	54	54	51	71		

Order of Pollutants According to Assumed Limits

Study Week	Exhaust System	1	2	3	4	5	6	7			
1	Catalyst	CO	NO_2	NO	SO_4	SO_2	RCD	AQI			
2	Ceramic Traps	CO	SO_4	NO_2	NO	RCD	SO_2	AQI			

Table 8 Continued

LHD-Upstream Slopes

Study Week	Exhaust System	CO, ppm/%	NO, ppm/%	NO_2, ppm/%	SO_4, mg/m^3/%	SO_2, ppm/%	TPM, mg/m^3/%	RCD mg/m^3/%	TPM-RCD mg/m^3/%	AQI/%	
1	Catalyst	14.39	75.47	6.64	3.56	7.57	31.10	14.63	16.48	43.40	
2	Ceramic Traps	22.56	71.47	8.92	1.08	9.93	25.09	9.35	15.74	31.14	

LHD-Upstream CO_2, % at Assumed Limit

Study Week	Exhaust System		CO	NO	NO_2	SO_4	SO_2	TPM	RCD	AQI	
1	Catalyst		3.48	0.33	0.75	0.28	0.26	0.16	0.14	0.092	
2	Ceramic Traps		2.22	0.35	0.56	0.93	0.20	0.20	0.21	0.13	

% of Total AQI at mean TWA CO_2,%

Study Week	Exhaust System			CO	NO	NO_2	SO_4	SO_2	RCD		
1	Catalyst			0.66	6.96	6.12	15.18	8.72	62.35		
2	Ceramic Traps			1.45	9.18	11.46	6.40	15.94	55.56		

The fact that the RCD slope is significantly lower for the ceramic traps would in itself seem to prove that they are effective in collecting diesel particulates. However, the data are confounded by the effect of the drill oil mist.

Unfortunately the Jumbo drill operated all four days during the first week when the catalytic convertors were installed, but operated only on Monday of the second week when the ceramic traps were installed. Thus, even if the traps had not been employed, a decrease in the LHD on-board RCD would probably have taken place after Monday of the second week. The data in Tables 5 and 6 give evidence of this confounding since RCD is slightly higher on Monday than on the other two days of the second week. This difference is also apparent in the downstream data (Appendix 2) where the second week Monday RCD slope was 15.0 while [illegible] values for Tuesday and Wednesday were 5.0 and 6.4. [illegible]heading data should not be greatly affected by drill oil and, in fact, there is little change between the first and second weeks heading RCD slopes (7.1 and 4.9 respectively - Appendix 2), or between the second week Monday RCD (drill working) and that for Tuesday and Wednesday (drill not working), where slopes are 5.1, 4.0 and 6.1 respectively.

From the above discussion it may be seen that comparing the slopes of the characteristic curves of the RCD from the catalytic convertors with those for RCD from the ceramic traps is a means of determining whether or not the traps reduced RCD. These characteristic curve slopes are useful in interpreting the data. There are a number of other useful calculated parameters and these are discussed in the following paragraphs.

The LHD-Upstream 'concentration as a % of assumed limit' shows how near the operating concentration of a pollutant or the AQI is to its limit. From these data it can be seen that AQI is the most stringent limit. RCD is the most critical pollutant when the catalysts are used, but when the ceramic traps are used TPM is most critical followed by SO_2 and then RCD.

The LHD-Upstream 'CO_2, at assumed limit' parameter lists (for each pollutant and the AQI) the CO_2 concentration to which the ventilation system must dilute the diesel-produced CO_2 to maintain the concentration of the pollutant at or below its assumed limit. For all of the assumed limits to be satisfied, dilution must attain the lowest CO_2 value in the Table 8. Thus we would recommend a maximum CO_2 concentration of 0.092% for the catalytic convertor and 0.13% for the ceramic traps. This recommended CO_2 control level for the traps would also require that a tailpipe monitoring program for particulates be implemented to insure that the traps are working.

These CO_2 concentrations would be used by the mine as limits to assure that sufficient ventilation air is available for the particular diesel operation. The limiting CO_2 concentrations may be expressed in terms of CFM/BHP which is directly related to the diesel-produced CO_2 concentration. Thus .092% CO_2 represents 221 CFM/BHP and .13 % CO_2 represents 156 CFM/BHP.

The 'desired control efficiency with CO_2 limiting' parameter gives the percentage reduction in the normalized concentration (slope) needed to cause all the measured pollutants to reach their assumed limits simultaneously. Since the CO_2 assumed limit

is 0.50% minus the upstream, the desired control efficiency is calculated for each pollutant as follows: Subtract the slope of the characteristic curve that passes through the TLV of the pollutant at 0.5% CO_2 minus the upstream from the actual slope of the characteristic curve for that pollutant (Table 8); then divide by this actual slope and multiply by 100.

The desired control efficiencies in Table 8 show that for the catalytic converters, AQI (78%) and in turn RCD (67%) need the most control. TPM is largely RCD of diesel origin so SO_2 is next at 36%. Negative values indicate that the pollutant is already overcontrolled in terms of these criteria.

We also see from these data that the order of pollutants needing control changes with the ceramic traps. Thus SO_2 and TPM are both 54% and RCD is 51%. SO_4 is shown to be overcontrolled with the traps since we assume only a small amount of the fuel sulfur (2.5% by weight) goes to SO_4 when the catalysts are not used.

The '% of total AQI at mean TWA CO_2, %' gives the relative contribution of each pollutant to the AQI. The data indicate that RCD contributed most to the AQI for both the catalytic convertors (62%) and the ceramic traps (56%). Because the fuel sulfur content was relatively high (0.19% and 0.23% for catalysts and traps respectively), the SO_4 was second at 15% for the catalytic convertors and SO_2 was second at 16% for the ceramic traps.

The above discussion shows that the pollutants can be ranked from least to most critical by at least two different criteria. The first criterion is the assumed individual concentration limit

or AQI and the second is by contribution of the pollutants to the AQI. The order according to the assumed limit is presented in the table and has already been discussed with the discussion of the 'operating concentration as a % of Assumed Limit' Parameters.

CONCLUSIONS

1. The study was successful in providing the CANMET personnel with hands-on experience in using the portable instruments and equipment purchased on the earlier contract.

2. The daily ambient pollutant data show that both the baseline week (catalytic convertors) and the week with the traps meet all the standards, TLVs and assumed limits. The measured pollutant concentrations and the characteristic curve slopes are similar to our past data in other mines.

3. The comparison of the RCD+SO_4 characteristic curve slopes for the two weeks shows that a reduction of 43% occured during the week the traps were used. This reduction may be attributed to the traps and to a simultaneous reduction in drill oil mist. The AQI was reduced by 31% with the traps if the fuel sulfur level is assumed to be equal for both weeks at 0.19%.

4. The data show that the AQI at a limit of 4 is the most stringent and the RCD at a limit of 2 mg/m^3 is the next most stringent for determining air flow requirements for this mine.

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2. Johnson, J.H., Monitoring Methods for Underground Diesel Pollutants, Diesels in Mining, World Mining/World Coal, November 1982.

3. Johnson, J.H. and Carlson, D.H., The Application of Advanced Measurement and Control Technology to Diesel Powered Vehicles in an Underground Salt Mine, Paper to be presented at the 1984 Annual General Meeting of the Canadian Institute of Mining and Metallurgy, Ottawa, Ontario, Canada, April 15-19, 1984.

4. Schaefer, P.M. and Johnson, J.H., Simulation of the Pollutant Concentration for a Conventional Side and a Modified Rear LHD Exhaust System - A Basis for an Engineering Approach to Diesel Pollutant Monitoring and Control in Underground Mines, to be published in the CIM Bulletin.

5. Osborne, M.D., Johnson, J.H. and Reinbold, E.O. [illegible]et of Catalysts and a Particulate Trap on Diesel [illegible]s in Underground Mining, to be published in the CIM [illegible]in.

APPENDIX 1

Maps of Study Area Showing Operations During the Various Dates

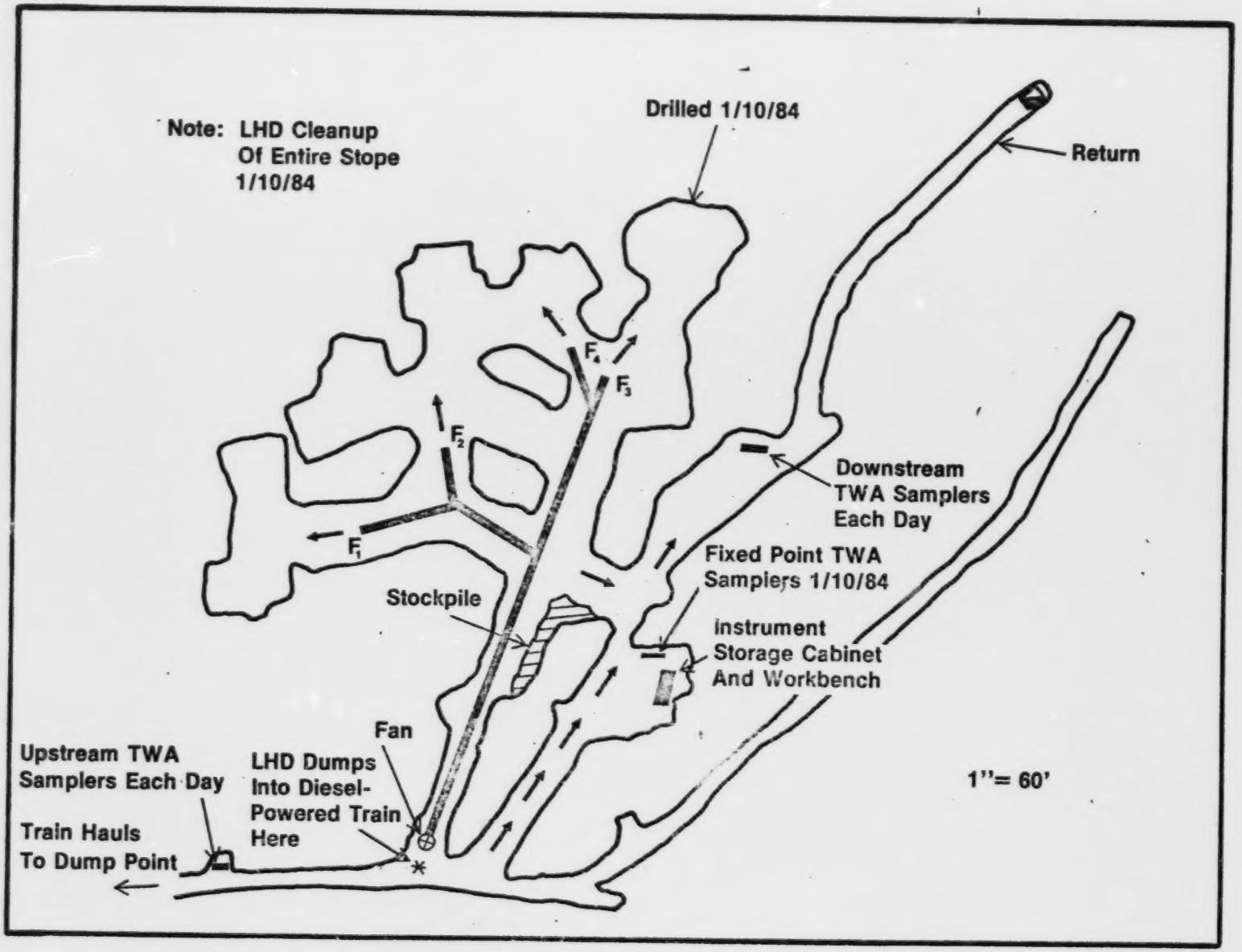

Figure 1-1. Study Area on 1/10/84

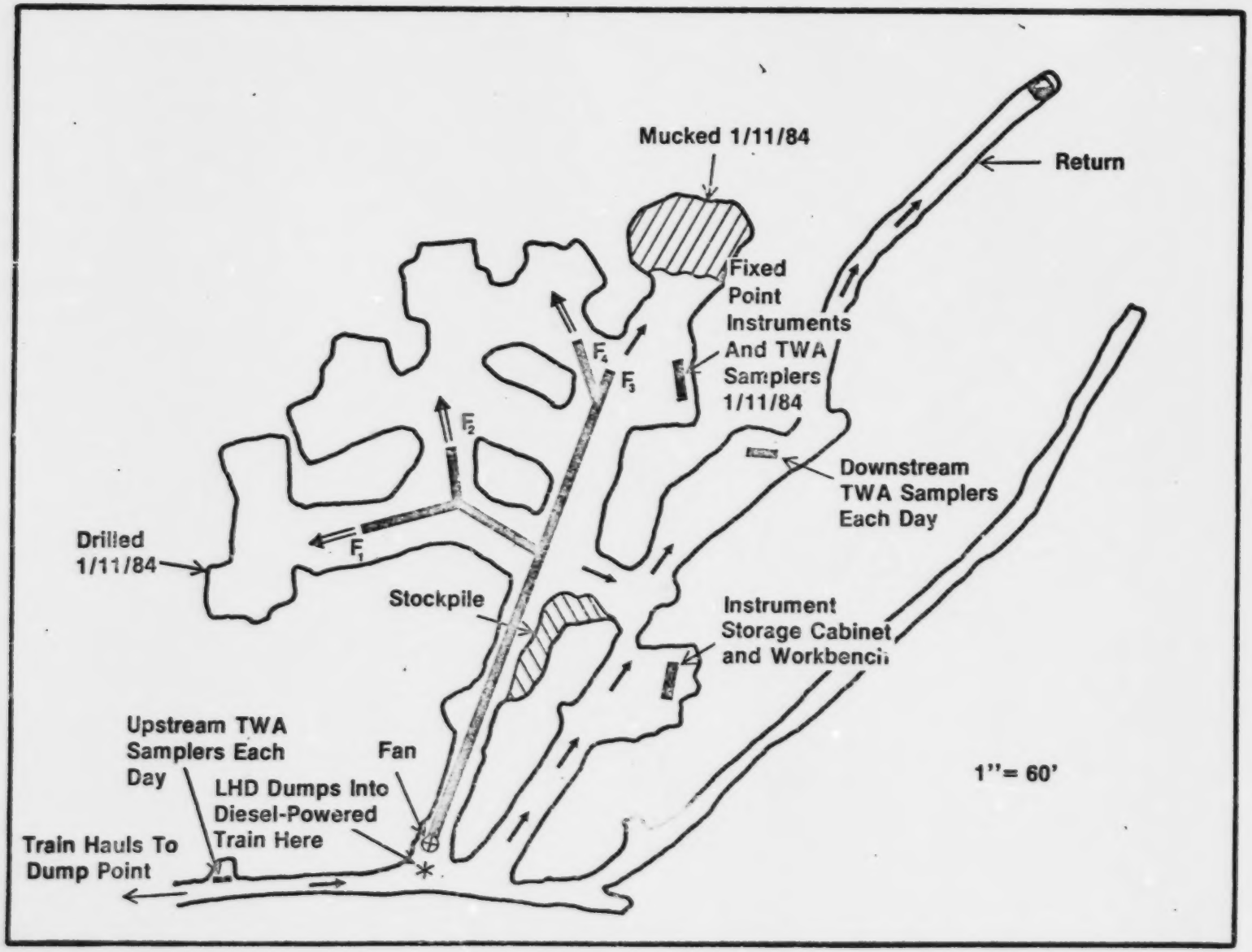

Figure 1-2. Study Area on 1/11/84.

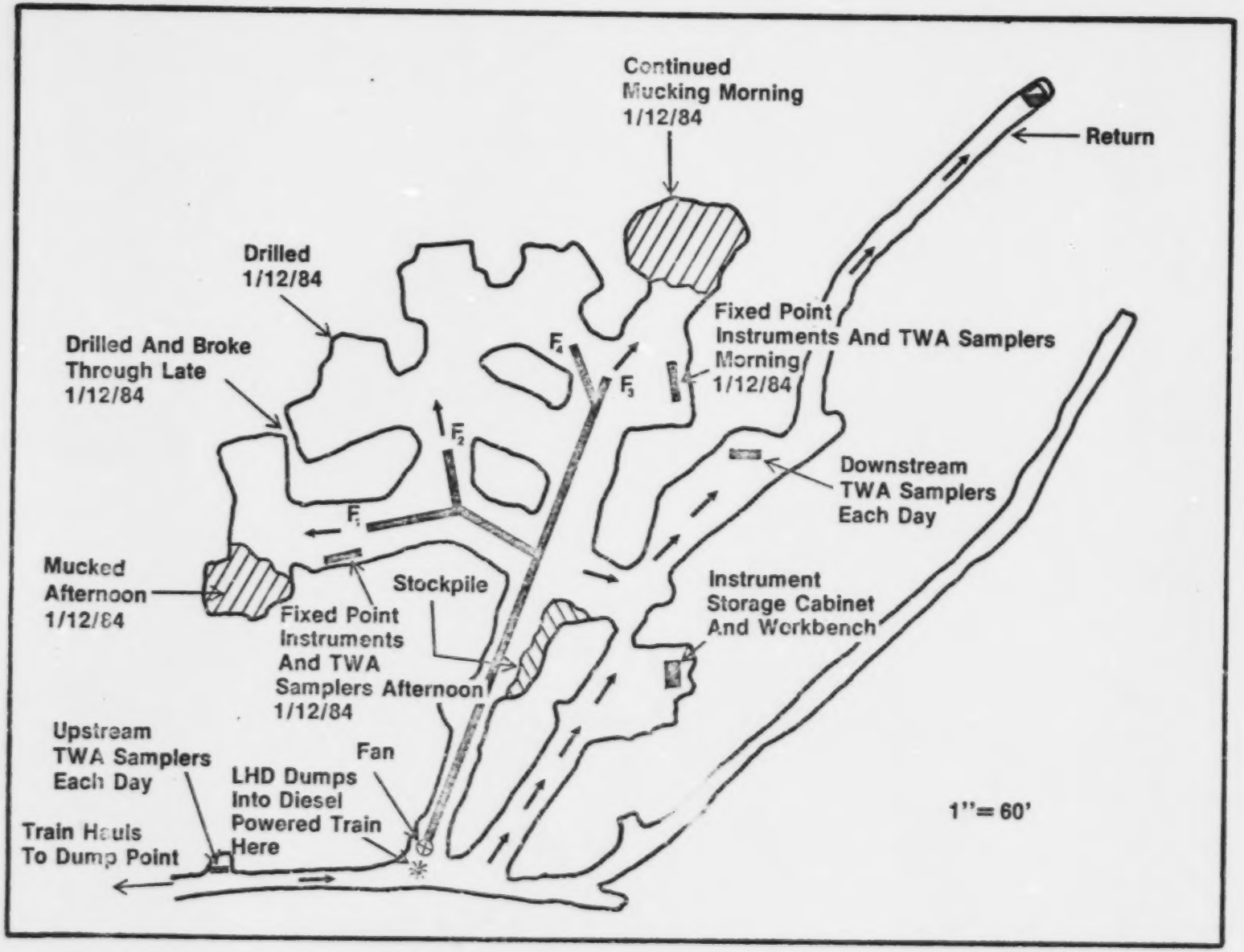

Figure 1-3. Study Area on 1/12/84.

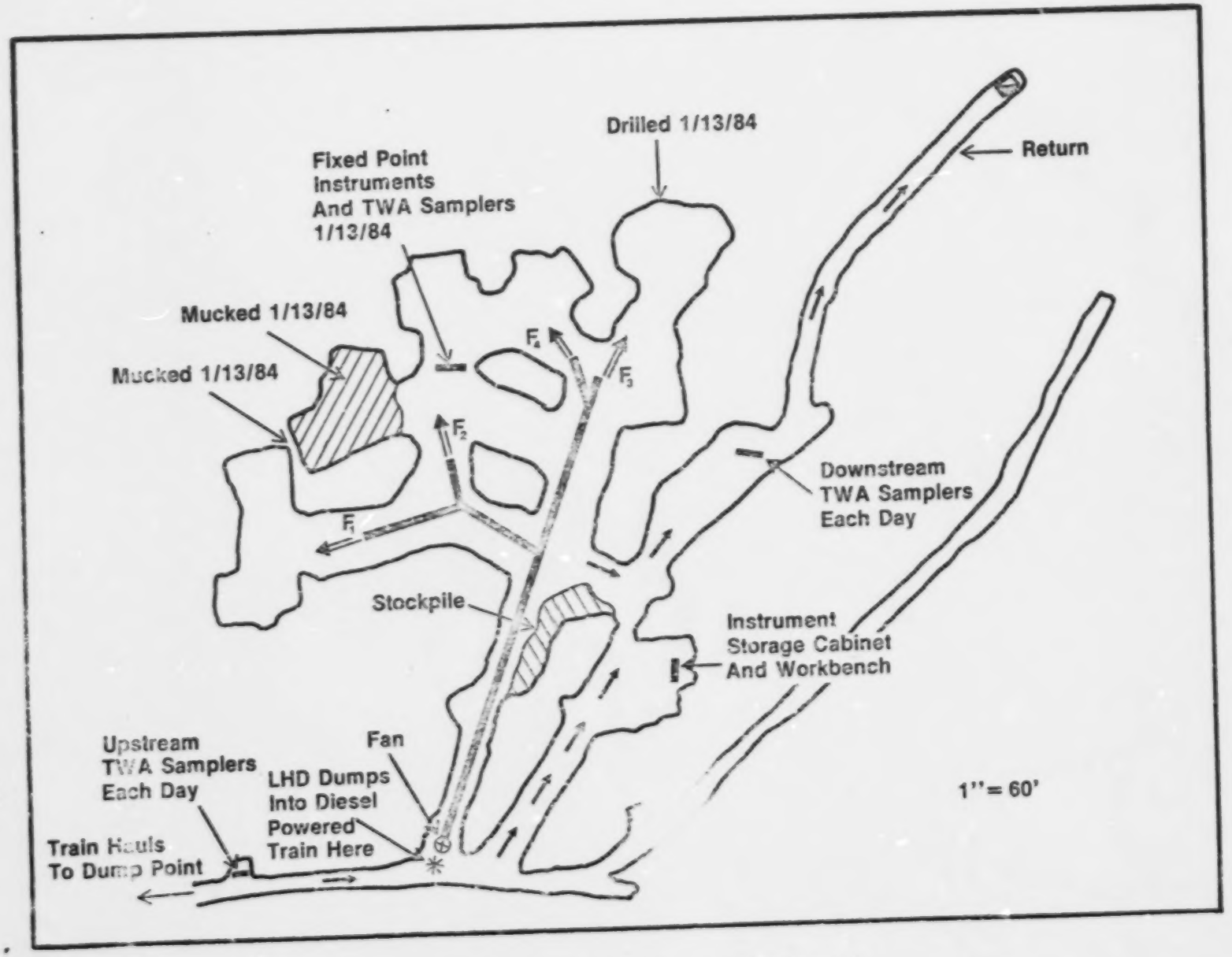

Figure 1-4. Study Area on 1/13/84.

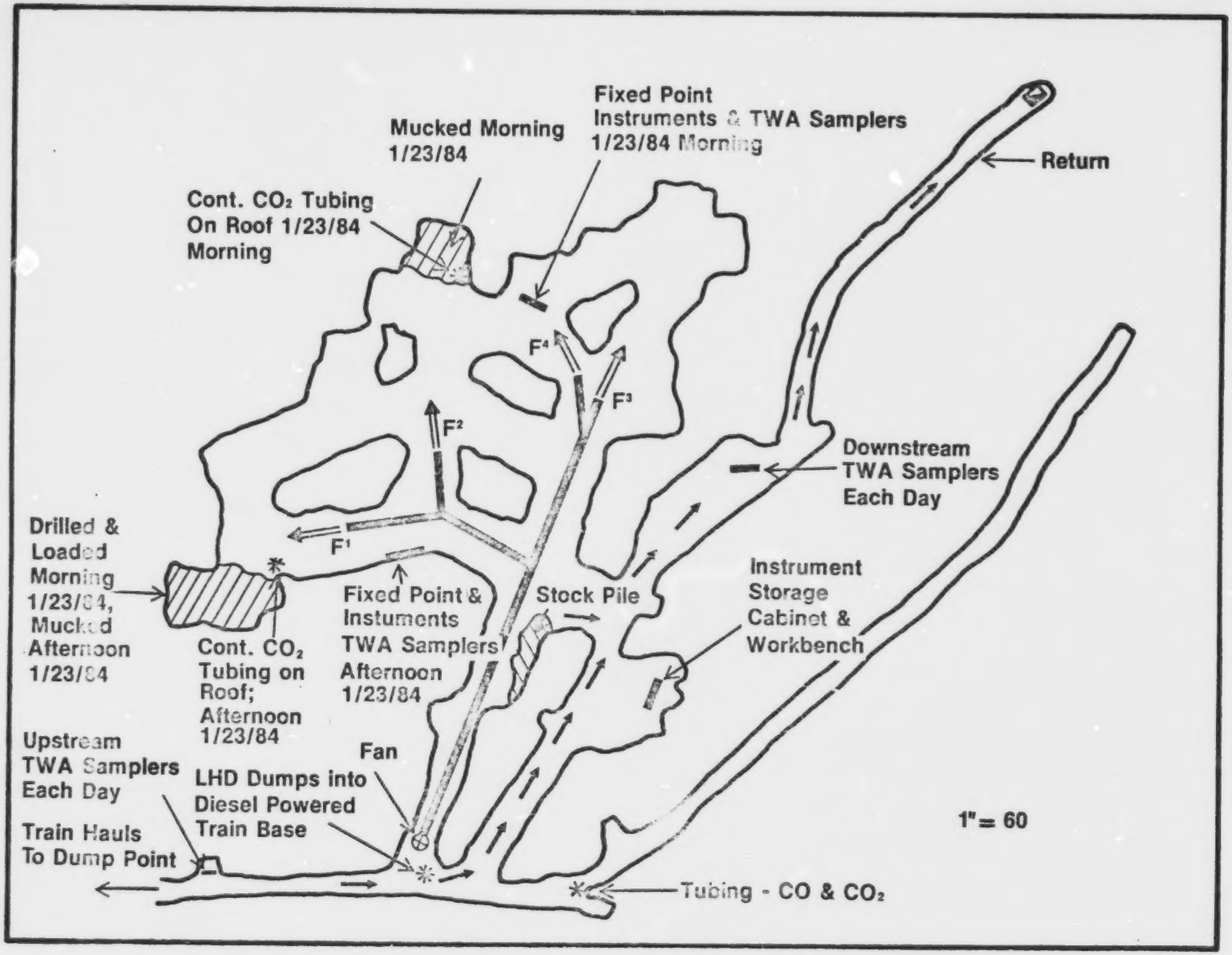

Figure 1-5. Study Area on 1/23/84.

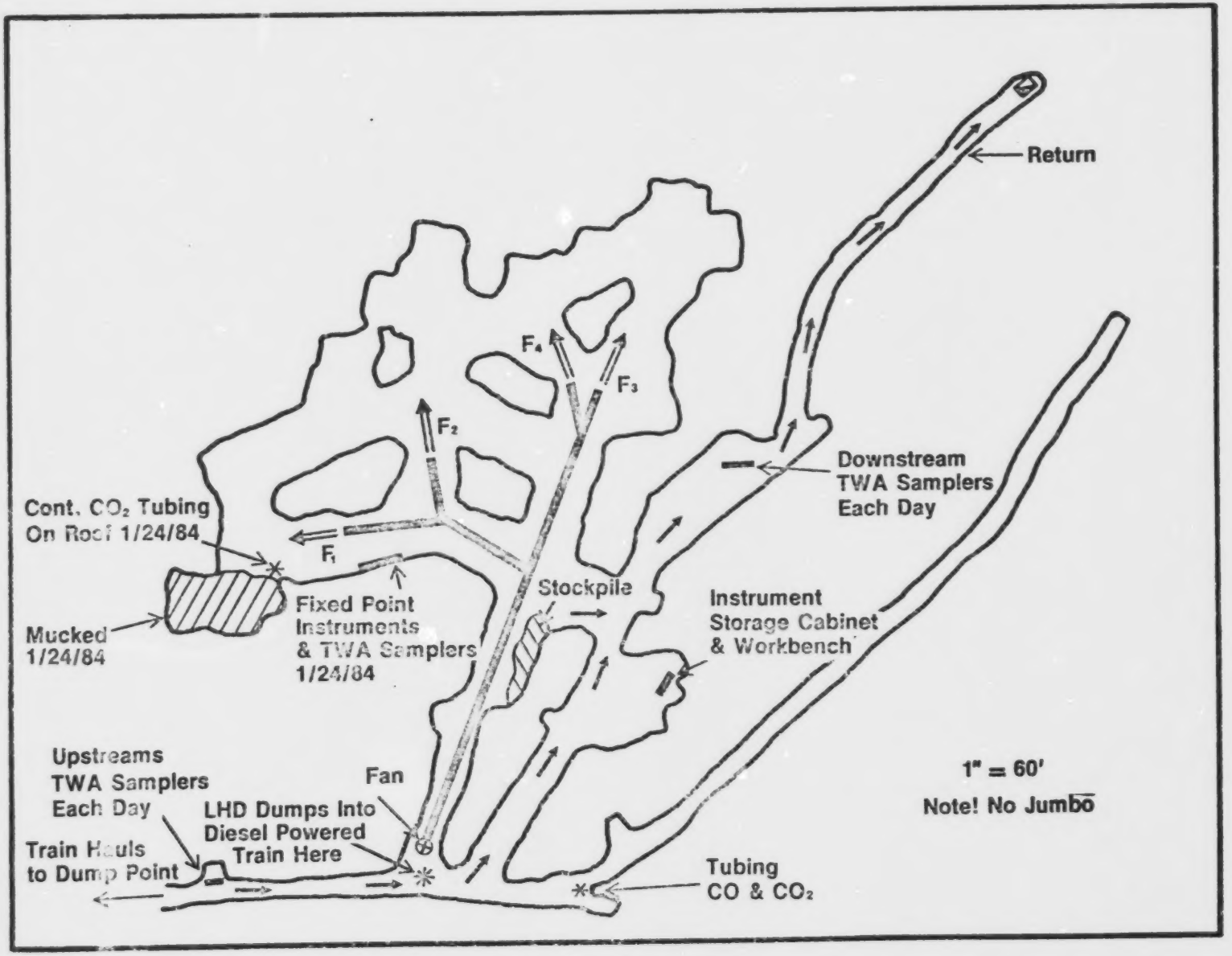

Figure 1-6. Study Area on 1/24/84.

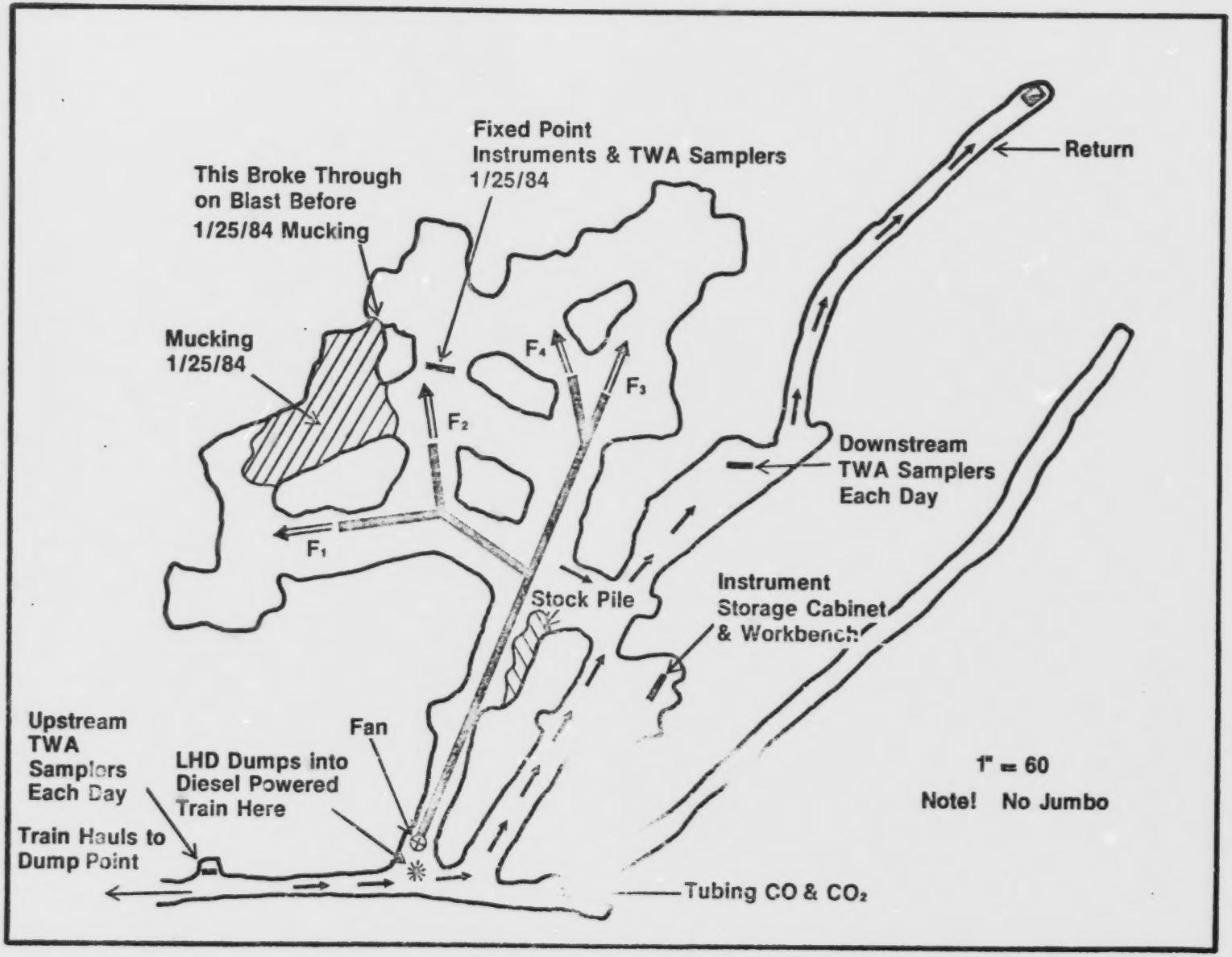

Figure 1-7. Study Area on 1/25/84.

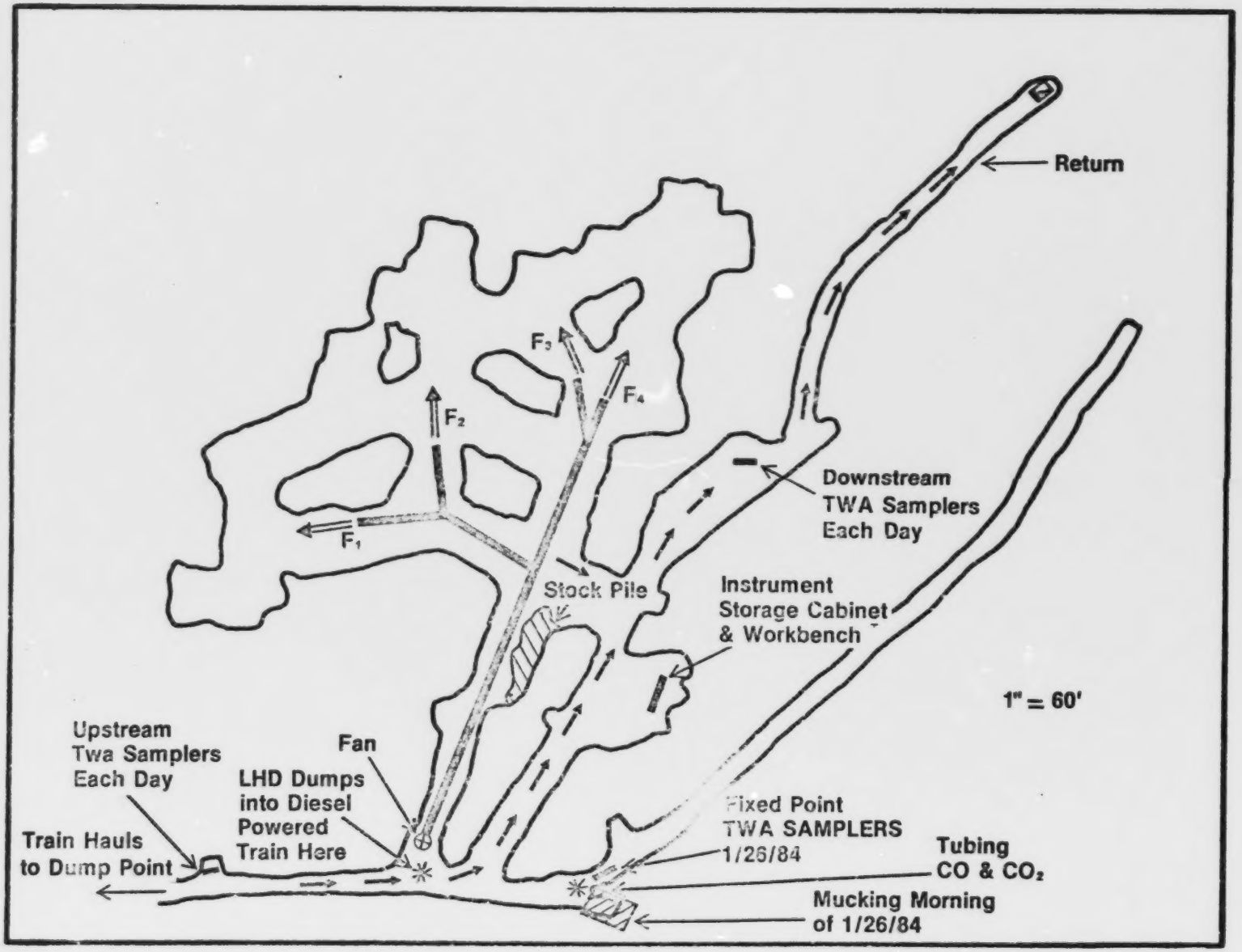

Figure 1-8. Study Area on 1/26/84.

APPENDIX 2

Analyzed Data for Upstream

Weeks 1 and 2

TRPM BLANK INFORMATION

BLANK	INITIAL FILTER WEIGHT MG	FINAL FILTER WEIGHT MG	DIFFERENCE MG
14	63.090	63.090	0
38	62.820	62.830	0.010
39	62.900	62.910	0.010
40	63.470	63.480	0.010
AVG			0.008
STD DEV			0.005

CARBON BLANK INFORMATION

BLANK	CARBON MG
14	0.015
38	0.010
39	0.014
40	0.008
AVG	0.012
STD DEV	0.003

HYDROGEN BLANK INFORMATION

BLANK	HYDROGEN MG
14	0.026
38	0.019
39	0.020
40	0.017
AVG	0.020
STD DEV	0.004

PARTICULATE MATTER INFORMATION

DATE	FILTER NUMBER	WEIGHT, MG INITIAL	WEIGHT, MG FINAL	DIFF., MG	CORR. DIFF., MG	RATE, LPM	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	EXPERIMENT TIME, HRS	TRPM, MG/MR**3
1/10	7	61.060	61.060	0	-0.008	4.750	9:13	1:26	4.217	-0.006
1/10	8	61.270	61.280	0.010	0.002	4.750	9:13	1:26	4.217	0.002
	AVG									-0.002
	STD DEV									0.006
1/11	11	59.950	60.070	0.120	0.112	4.750	8: 7	8:35	4.950	0.080
							9:10	11:30		
							12:25	2:34		
1/11	12	61.240	61.340	0.100	0.092	4.750	8: 7	8:35	4.950	0.066
							9:10	11:30		
							12:25	2:34		
	AVG									0.073
	STD DEV									0.010
1/12	20	67.310	67.440	0.130	0.123	4.750	8:18	11:20	4.850	0.089
							12:20	2: 9		
1/12	21	61.550	61.700	0.150	0.143	4.750	8:18	11:20	4.850	0.103
							12:20	2: 9		
	AVG									0.096
	STD DEV									0.010
1/13	31	70.170	70.260	0.090	0.083	4.750	1: 5	5: 0	5.667	0.051
							5:20	7: 5		
1/13	32	70.800	70.870	0.070	0.063	4.750	1: 5	5: 0	5.667	0.039
							5:20	7: 5		
	AVG									0.045
	STD DEV									0.009
1/23	42	70.410	70.700	0.290	0.282	4.750	8:25	11:22	4.867	0.204
							12:12	2: 7		
	AVG									0.204
1/24	35	63.550	63.800	0.250	0.242	4.750	8:45	11:32	4.650	0.183
							12:33	2:25		
1/24	33	70.960	71.160	0.200	0.193	4.250	8:45	11:32	4.650	0.162
							12:33	2:25		
	AVG									0.173
	STD DEV									0.015
1/25	7	62.940	63.140	0.200	0.193	4.750	8:28	11:24	5.150	0.131
							12:25	2:38		

1/25		8	68.570	68.790	0.220	0.21[illegible]		.750	6:28		11:24		5.150	0.145			
									12:25		2:38						
AVG														0.138			
STD DEV														0.010			

DATE	FILTER NUMBER	CARBON, MG	HYDROGEN, MG	CORR. C, MG	CORR. H, MG	C+H, MG	C+H, MG/M**3
1/10	7	0.058	0.025	0.040	0.005	0.051	0.043
1/10	8	0.053	0.023	0.042	0.003	0.044	0.037
AVG							0.040
STD DEV							0.004
1/11	11	0.071	0.024	0.059	0.004	0.063	0.044
1/11	12	0.074	0.025	0.062	0.005	0.067	0.047
AVG							0.046
STD DEV							0.002
1/12	20	0.137	0.040	0.125	0.019	0.145	0.105
1/12	21	0.078	0.020	0.066	0.005	0.071	0.052
AVG							0.078
STD DEV							0.037
1/13	31	0.097	0.032	0.085	0.011	0.096	0.069
1/13	32	0.079	0.028	0.067	0.007	0.074	0.040
AVG							0.053
STD DEV							0.010
1/23	34	0.037	0.022	0.025	0.002	0.027	0.019
1/23	42	0.045	0.024	0.033	0.004	0.037	0.027
AVG							0.023
STD DEV							0.005
1/24	35	0.092	0.024	0.080	0.004	0.084	0.063
1/24	33	0.079	0.020	0.068	0.005	0.073	0.055
AVG							0.059
STD DEV							0.006
1/25	7	0.097	0.029	0.085	0.009	0.094	0.064
1/25	8	0.078	0.020	0.066	0.006	0.072	0.049
AVG							0.057
STD DEV							0.011

NO2

DATE	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	TIME/ HRS	SAMPLER NO.	PPM-HRS	PPM	CORR. FOR TEMP/ PPM	CORR. FOR TEMP & INSTR/ PPM
1/10	9:13	1:20	4.217	1038	1.000	0.237	0.377	0.377
	9:13	1:20	4.217	1098	1.700	0.403	0.641	0.641
	9:13	1:20	4.217	1108	1.500	0.356	0.566	0.566
Avg								0.528
STD DEV								0.136
1/11	8: 7	8:35	4.950	1120	1.800	0.364	0.578	0.578
	9:10	11:30						
	12:25	2:34						
	8: 7	8:35	4.950	1110	1.500	0.303	0.482	0.482
	9:10	11:30						
	12:25	2:34						
	8: 7	8:35	4.950	1097	1.800	0.364	0.578	0.578
	9:10	11:30						
	12:25	2:34						
Avg								0.540
STD DEV								0.050
1/12	8:18	11:20	5.117	1084	1.500	0.293	0.466	0.466
	12:20	2:25						
	8:18	11:20	4.850	1064	1.000	0.206	0.328	0.328
	12:20	2: 9						
	8:18	11:20	4.850	1063	1.200	0.247	0.393	0.393
	12:20	2: 9						
Avg								0.396
STD DEV								0.069
1/13	1: 5	5: 0	5.667	1104	1.300	0.229	0.365	0.365
	5:20	7: 5						
	1: 5	5: 0	5.667	1134	1.400	0.247	0.393	0.393
	5:20	7: 5						
	1: 5	5: 0	5.667	1113	1.500	0.265	0.421	0.421
	5:20	7: 5						
Avg								0.393
STD DEV								0.028

1/23									
	8:25 12:12	11:22 2: 7	4.867	1205	0.500	0.103	0.163	0.163	
	8:25 12:12	11:22 2: 7	4.867	1206	1.600	0.329	0.523	0.523	
AVG STD DEV								0.343 0.254	
1/24									
	8:45 12:33	11:32 2:25	4.650	1215	1.000	0.344	0.547	0.547	
	8:45 12:33	11:32 2:25	4.650	1217	1.900	0.409	0.650	0.650	
AVG STD DEV								0.598 0.073	
1/25									
	8:28 12:25	11:24 2:38	5.150	1167	1.100	0.214	0.340	0.340	
	8:28 12:25	11:24 2:38	5.150	1171	1.200	0.233	0.370	0.370	
AVG STD DEV								0.355 0.022	
1/26									
	8:44 8:44	11:27 11:27	2.717 2.717	1253 1252	2.000 0.700	0.730 0.258	1.171 0.410	1.171 0.410	
AVG STD DEV								0.790 0.538	

DATE		NOX SAMPLER NO.	NOX PPM-HRS	NOX PPM	NO NOX-AVG NO2, PPM	NO CORR. FOR TEMP, PPM	NO CORR. FOR TEMP & INSTR, PPM
1/10		1057	2.700	0.640	0.112	0.126	0.126
		1117	2.900	0.688	0.160	0.179	0.179
		1039	3.200	0.759	0.231	0.259	0.259
	AVG			0.696			0.188
	STD DEV			0.060			0.067
1/11		1109	4.100	0.828	0.282	0.316	0.316
		1080	4.200	0.848	0.302	0.339	0.339
		1089	3.800	0.765	0.219	0.245	0.245
	AVG			0.814			0.300
	STD DEV			0.043			0.049
1/12		1082	3.900	0.804	0.408	[illegible]	0.457
		1102	3.800	0.784	0.388	0.434	0.434
		1130	4.000	0.825	0.429	0.480	0.480
	AVG			0.804			0.457
	STD DEV			0.021			0.023
1/13		1106	4.300	0.887	0.494	0.553	0.553
		1105	4.800	0.990	0.597	0.668	0.668
		1086	4.300	0.887	0.494	0.553	0.553
	AVG			0.921			0.592
	STD DEV			0.060			0.067
1/23		1195	3.000	0.616	0.273	0.306	0.306
		1191	4.000	0.822	0.479	0.536	0.536
	AVG			0.719			0.421
	STD DEV			0.145			0.163
1/24		1223	4.000	0.860	0.262	0.293	0.293

			1232	4.200	0.903	0.505	0.341	0.341
		AVG			0.882			0.317
		STD DEV			0.030			0.034
	1/25							
			1176	4.400	0.854	0.499	0.559	0.559
			1180	4.900	0.939	0.564	0.654	0.654
		AVG			0.897			0.607
		STD DEV			0.060			0.067
	1/26							
			1240	6.000	2.209	1.418	1.589	1.589
			1244	4.100	1.509	0.719	0.805	0.805
			1241	5.900	2.172	1.382	1.547	1.547
		AVG			1.903			1.314
		STD DEV			0.394			0.441

	TEMPERATURE CORRECTION FACTOR	INSTRUMENT CORRECTION FACTOR
NO2	1.550	1.000
NO	1.120	1.000

APPENDIX 3

Analyzed Data for LHD

Weeks 1 and 2

TRPM BLANK INFORMATION

BLANK	INITIAL FILTER WEIGHT MG	FINAL FILTER WEIGHT MG	DIFFERENCE MG
14	63.090	63.090	0
38	62.820	62.830	0.010
39	62.900	62.910	0.010
40	63.470	63.480	0.010
AVG			0.006
STD DEV			0.005

CARBON BLANK INFORMATION

BLANK	CARBON MG
14	0.015
38	0.019
39	0.014
40	0.008
AVG	0.012
STD DEV	0.005

HYDROGEN BLANK INFORMATION

BLANK	HYDROGEN MG
14	0.020
38	0.019
39	0.021
40	0.017
AVG	0.020
STD DEV	0.004

PARTICULATE MATTER INFORMATION

DATE	FILTER NUMBER	WEIGHT, MG INITIAL	WEIGHT, MG FINAL	DIFF., MG	CORR. DIFF., MG	RATE, LPM	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	EXPERIMENT TIME, HRS	TRPM, MG/M**3
1/10	1	60.930	65.310	4.380	4.373	4.750	8:25	1:55	5.500	2.789
1/10	2	68.560	73.080	4.520	4.513	4.750	8:25	1:55	5.500	2.879
	AVG									2.834
	STD DEV									0.063
1/11	9	61.060	63.540	2.480	2.472	4.750	8:10	8:35	4.917	1.764
							9: 5	11:30		
							12:25	2:30		
1/11	10	61.390	63.820	2.430	2.422	4.750	8:10	8:35	4.917	1.729
							9: 5	11:30		
							12:25	2:30		
	AVG									1.747
	STD DEV									0.025
1/12	18	70.770	74.090	3.320	3.312	4.750	8:54	11:20	4.517	2.573
							12:20	2:25		
1/12	19	69.600	73.330	3.730	3.723	4.750	8:54	11:20	4.517	2.892
							12:20	2:25		
	AVG									2.733
	STD DEV									0.225
1/13	27	67.640	70.290	2.650	2.643	4.750	12:55	5: 0	6.167	1.504
							5:20	7:25		
1/13	49	70.950	73.760	2.810	2.802	4.750	12:55	5: 0	6.167	1.595
							5:20	7:25		
	AVG									1.549
	STD DEV									0.064
1/23	45	71.270	73.890	2.620	2.612	4.750	8:11	11:19	5.317	1.724
							12:19	2:30		
1/23	46	71.150	73.730	2.580	2.572	0	8:11	11:19	5.317	1.698
							12:19	2:30		
	AVG									1.711
	STD DEV									0.019
1/24	48	69.580	72.400	2.820	2.812	4.750	8:24	11:30	5.167	1.910
							12:33	2:37		
1/24	52	60.660	63.430	2.770	2.762	4.750	8:24	11:30	5.167	1.876
							12:33	2:37		
	AVG									1.893
	STD DEV									0.024

1/25	0	59.890	62.460	2.570	2.562	4.750	8:15 12:27	11:14 2:23		4.917	1.829	
1/25	4	68.400	71.040	2.640	2.633	4.750	8:15 12:27	11:14 2:23		4.917	1.879	
	AVG STD DEV										1.854 0.035	

DATE	FILTER NUMBER	CARBON, MG	HYDROGEN, MG	CORR. C, MG	CORR. H, MG	C+H, MG	C+H, MG/M**3
1/10	1	1.940	0.305	1.934	0.284	2.218	1.415
1/10	2	2.050	0.322	2.044	0.301	2.345	1.496
	AVG						1.456
	STD DEV						0.057
1/11	9	0.944	0.151	0.932	0.130	1.062	0.758
1/11	10	0.953	0.155	0.941	0.135	1.076	0.768
	AVG						0.763
	STD DEV						0.007
1/12	18	1.451	0.207	1.439	0.187	1.626	1.263
1/12	19	1.506	0.224	1.494	0.203	1.697	1.318
	AVG						1.291
	STD DEV						0.039
1/13	27	1.214	0.182	1.202	0.162	1.364	0.776
1/13	49	1.217	0.185	1.205	0.165	1.370	0.779
	AVG						0.778
	STD DEV						0.002
1/23	45	1.078	0.169	1.060	0.149	1.215	0.802
1/23	46	1.071	0.176	1.059	0.156	1.215	0.802
	AVG						0.802
	STD DEV						0
1/24	48	0.797	0.131	0.785	0.111	0.895	0.606
1/24	52	0.833	0.126	0.791	0.106	0.897	0.609
	AVG						0.608
	STD DEV						0.001
1/25	6	0.693	0.106	0.681	0.086	0.767	0.547
1/25	9	0.748	0.114	0.736	0.093	0.830	0.592
	AVG						0.570
	STD DEV						0.032

NO2

DATE	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	TIME, HRS	SAMPLER NO.	PPM-HRS	PPM	CORR. FOR TEMP, PPM	CORR. FOR TEMP & INSTR, PPM
1/10								
	8:25	1:55	5.500	1040	3.000	0.545	0.753	0.753
	8:25	1:55	5.500	1049	2.700	0.491	0.677	0.677
AVG								0.715
STD DEV								0.053
1/11								
	8:10	8:35						
	9: 5	11:30	4.917	1100	3.100	0.631	0.870	0.870
	12:25	2:30						
	8:10	8:35						
	9: 5	11:30	4.917	1090	3.100	0.631	0.870	0.870
	12:25	2:30						
	8:10	8:35						
	9: 5	11:30	4.917	1071	3.700	0.753	1.039	1.039
	12:25	2:30						
AVG								0.926
STD DEV								0.097
1/12								
	8:54	11:20						
	12:20	2:25	4.517	1132	2.500	0.554	0.764	0.764
	8:54	11:20						
	12:20	2:25	4.517	1073	2.800	0.620	0.855	0.855
AVG								0.810
STD DEV								0.065
1/13								
	12:55	5: 0						
	5:20	5:25	4.167	1114	3.300	0.792	1.093	1.093
	12:55	5: 0						
	5:20	5:25	4.167	1055	3.900	0.936	1.292	1.292
	12:55	5: 0						
	5:20	5:25	4.167	1113	4.200	1.008	1.391	1.391
AVG								1.259
STD DEV								0.152
1/23								
	8:11	11:19	5.317	1208	3.500	0.658	0.908	0.908

	12:19	2:30							
	8:11 12:19	11:19 2:30	5.317	1210	3.600	0.715	0.980	0.980	
Avg STD DEV								0.947 0.055	
1/24									
	8:24 12:33	11:30 2:37	5.167	1214	3.300	0.639	0.881	0.881	
	8:24 12:33	11:30 2:37	5.167	1212	3.900	0.755	1.042	1.042	
	8:24 12:33	11:30 2:37	5.167	1213	3.300	0.639	0.881	0.881	
Avg STD DEV								0.935 0.093	
1/25									
	8:15 12:27	11:14 2:23	4.917	1163	2.200	0.447	0.617	0.617	
	8:15 12:27	11:14 2:23	4.917	1105	1.800	0.366	0.505	0.505	
	8:15 12:27	11:14 2:23	4.917	1172	2.400	0.488	0.674	0.674	
Avg STD DEV								0.599 0.086	
1/26									
	8:15 8:15	11:20 11:20	3.083 3.083	1251 1249	4.100 5.600	1.330 1.816	1.835 2.506	1.835 2.506	
Avg STD DEV								2.171 0.475	

DATE		SAMPLER NO.	PPM-MRS	NOX PPM	NO NOX-AVG NO2, PPM	NO CORR. FOR TEMP, PPM	NO CORR. FOR TEMP & INSTR, PPM
1/10							
		1088	35.000	6.364	5.649	6.326	6.326
		1127	31.800	5.782	5.067	5.675	5.675
		1048	24.600	4.473	3.758	4.209	4.209
	AVG			5.539			5.403
	STD DEV			0.908			1.085
1/11							
		1042	29.000	5.898	4.972	5.569	5.569
	AVG			5.898			5.569
1/12							
		1092	20.800	5.934	5.124	5.739	5.739
		1122	45.500	9.031	8.821	9.880	9.880
		1053	30.600	6.775	5.965	6.681	6.681
	AVG			7.446			7.433
	STD DEV			1.938			2.171
1/13							
		1075	30.600	4.962	3.704	4.148	4.148
		1046	30.200	4.897	3.639	4.075	4.075
	AVG			4.930			4.112
	STD DEV			0.046			0.051
1/23							
		1193	30.400	5.718	4.770	5.343	5.343
		1188	27.000	5.078	4.131	4.627	4.627
		1190	31.400	5.906	4.959	5.554	5.554
	AVG			5.567			5.174
	STD DEV			0.434			0.486
1/24							
		1230	38.000	7.355	6.420	7.190	7.190
		1224	37.400	7.239	6.304	7.060	7.060
		1229	35.000	6.890	5.955	6.670	6.670

	AVG			7.101			8.974
	STD DEV			0.242			0.271
1/25							
		1175	39.000	7.932	7.333	8.213	8.213
		1160	29.000	6.020	5.422	6.072	6.072
		1184	14.300	2.908	2.310	2.587	2.587
	AVG			5.620			5.624
	STD DEV			2.536			2.640
1/26							
		1242	14.500	4.703	2.532	2.836	2.836
		1245	10.300	3.341	1.170	1.310	1.310
		1243	8.800	2.854	0.683	0.765	0.765
	AVG			3.632			1.637
	STD DEV			0.958			1.073

	TEMPERATURE CORRECTION FACTOR	INSTRUMENT CORRECTION FACTOR
NO2	1.380	1.000
NO	1.120	1.000

DESCRIPTION: THIS SECTION TABULATES THE FOLLOWING INFORMATION FOR EACH POLLUTANT:

* LHD
* DIFFERENCE
* % DIFFERENCE
* SLOPES OF POLLUTANTS
* CO2,% AT TLV
* % OF POLLUTANT'S TLV
* DESIRED CONTROL EFFICIENCY

PROJECT: LITTLE STOBIE MINE

DATE : JANUARY 10 - JANUARY 13,1984

FUEL INFORMATION (ASSUMED) :

BSFC = 0.440

DATE	CONVERSION OF FUEL TO SO4(%)	PERCENT SULFUR
1/10	10.00	0.190
1/11	10.00	0.190
1/12	10.00	0.190
1/13	10.00	0.190

AQI = CO/50 + NO/25 + RCD/2 + 1.5(SO2/3 + RCD/2) + 1.2(NO2/3 + RCD/2)

1979 ACGIH TLV'S AND ASSUMED LIMITS

POLLUTANT	LIMIT	BASIS OF LIMIT
CO	50.0 PPM	1979 ACGIH TLV*
NO	25.0 PPM	1979 ACGIH TLV
NO2	5.0 PPM	1979 ACGIH TLV
TPM	5.0 MG/M**3	ASSUMED
RCD	2.0 MG/M**3	ASSUMED**
SO4	1.0 MG/M**3	1979 ACGIH TLV
SO2	2.0 PPM	1979 ACGIH TLV

* ONTARIO REGULATIONS
** COAL STANDARD

POLLUTANT CONCENTRATIONS

LHD

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10	0.161	3.30	5.40	0.71	2.83
1/11	0.148	2.00	5.57	0.93	1.75
1/12	0.161	3.00	7.43	0.81	2.73
1/13	0.145	3.40	4.11	1.26	1.55
AVG	0.154	2.92	5.63	0.93	2.22

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	1.46	1.38	0.29	0.61	4.10
1/11	0.76	0.98	0.22	0.48	2.70
1/12	1.29	1.44	0.27	0.58	3.86
1/13	0.79	0.77	0.21	0.44	2.78
AVG	1.07	1.14	0.25	0.53	3.36

POLLUTANT CONCENTRATIONS

UPSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	[illegible], PPM	TPM, MG/M**3
1/10	0.030	2.80	0.19	0.53	0.00
1/11	0.085	1.30	0.30	0.55	0.07
1/12	0.045	2.00	0.46	0.40	0.10
1/13	0.037	1.60	0.59	0.39	0.04
AVG	0.084	1.92	0.38	0.47	0.05

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	0.04	-0.04	0	0	0.32
1/11	0.05	0.03	0	0	0.31
1/12	0.08	0.02	0	0	0.30
1/13	0.06	-0.01	0	0	0.28
AVG	0.06	-0.00	0	0	0.30

DIFFERENCE, LHD - UPSTREAM

CONCENTRATION

DATE	CO2,%	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10	0.031	0.50	5.22	0.19	2.83
1/11	0.063	0.70	5.27	0.38	1.67
1/12	0.076	1.00	6.98	0.41	2.64
1/13	0.058	1.80	3.52	0.87	1.50
AVG	0.069	1.00	5.24	0.46	2.16

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	1.42	1.42	0.29	0.61	3.75
1/11	0.72	0.96	0.22	0.48	2.36
1/12	1.21	1.42	0.27	0.58	3.50
1/13	0.72	0.78	0.21	0.44	2.46
AVG	1.02	1.15	0.25	0.53	3.02

SLOPES OF POLLUTANT VS. CO2,%

LHD-UPSTREAM

DATE	CO2,%	CO, PPM/%	NO, PPM/%	NO2, PPM/%	TPM, MG/M**3/%
1/10	1.000	6.17	64.38	2.31	34.96
1/11	1.000	11.11	83.63	6.03	26.57
1/12	1.000	13.16	91.79	5.45	34.70
1/13	1.000	31.03	60.69	14.93	25.93
AVG	1.000	14.39	75.47	6.64	31.10

DATE	RCD, MG/M**3/%	TPM-RCD, MG/M**3/%	SO4, MG/M**3/%	SO2, PPM/%	AQI, AQI/%
1/10	17.48	17.48	3.56	7.57	46.34
1/11	11.38	15.19	3.56	7.57	37.41
1/12	15.96	18.74	3.56	7.57	46.01
1/13	12.41	13.52	3.56	7.57	42.36
AVG	14.63	16.48	3.56	7.57	43.40

CO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THRCUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	3.1	50.0	1.0	6.2	119.0	-1828.6
1/11	4.5	50.0	1.4	11.1	120.5	-984.3
1/12	3.8	50.0	2.0	13.2	120.5	-815.7
1/13	1.6	50.0	3.6	31.0	121.1	-290.1
AVG	3.5	50.0	2.0	14.4	120.3	-735.8

NO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THRCUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.4	25.0	20.9	64.4	59.5	7.5
1/11	0.3	25.0	21.1	33.6	60.2	28.0
1/12	0.3	25.0	27.9	91.8	60.2	34.4
1/13	0.4	25.0	14.1	60.7	60.5	0.3
AVG	0.3	25.0	21.0	75.5	60.1	20.3

NO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	2.2	5.0	3.7	2.3	11.9	-415.7
1/11	0.8	5.0	7.6	6.0	12.0	-99.7
1/12	0.9	5.0	8.3	5.4	12.0	-121.2
1/13	0.3	5.0	17.3	14.9	12.1	18.9
AVG	0.8	5.0	9.2	6.6	12.0	-81.0

TPM CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.1	5.0	56.6	35.0	11.9	66.0
1/11	0.2	5.0	33.5	26.6	12.0	54.7
1/12	0.1	5.0	52.7	34.7	12.0	65.3
1/13	0.2	5.0	30.1	25.9	12.1	53.3
AVG	0.2	5.0	43.2	31.1	12.0	61.3

RCD CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.1	2.0	70.3	17.5	4.8	72.6
1/11	0.2	2.0	35.9	11.4	4.8	57.7
1/12	0.1	2.0	60.6	16.0	4.8	69.8
1/13	0.2	2.0	36.0	12.4	4.8	61.0
AVG	0.1	2.0	50.8	14.6	4.8	67.1

SO4 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.3	1.0	28.9	3.6	2.4	33.2
1/11	0.3	1.0	22.4	3.6	2.4	32.3
1/12	0.3	1.0	27.1	3.6	2.4	32.3
1/13	0.3	1.0	20.7	3.6	2.4	32.0
AVG	0.3	1.0	24.8	3.6	2.4	32.3

SO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.3	2.0	30.7	7.6	4.8	37.1
1/11	0.3	2.0	23.8	7.6	4.8	36.3
1/12	0.3	2.0	23.8	7.6	4.8	36.3
1/13	0.3	2.0	22.0	7.6	4.8	36.0
AVG	0.3	2.0	26.3	7.6	4.8	36.5

AQI CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, AQI	CONC. AS % OF TLV	ACTUAL SLOPE, AQI/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, AQI/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.1	4.0	93.8	46.3	9.5	79.4
1/11	0.1	4.0	56.9	37.4	9.6	74.2
	0.1	4.0	37.4	46.0	9.6	79.1
	0.1	4.0	61.4	42.4	9.7	77.1
AVG	0.1	4.0	75.4	43.4	9.6	77.3

CO2, % AT TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/10	8.100	0.388	2.166	0.143	0.114	0.281	0.264	0.086
1/11	4.500	0.299	0.829	0.188	0.176	0.281	0.264	0.107
1/12	3.800	0.272	0.918	0.144	0.125	0.281	0.264	0.087
1/13	1.611	0.412	0.335	0.193	0.161	0.281	0.264	0.094
AVG	3.475	0.331	0.753	0.161	0.137	0.281	0.264	0.092

CONCENTRAION AS % OF POLLUTANT'S TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/10	1.0	20.9	3.7	56.6	70.8	28.9	30.7	93.8
1/11	1.4	21.1	7.6	33.5	35.8	22.4	23.8	58.9
1/12	2.0	27.9	8.3	52.7	60.6	27.1	28.8	87.4
1/13	3.6	14.1	17.3	30.1	36.0	20.7	22.0	61.4
AVG	2.0	21.0	9.2	43.2	50.8	24.8	26.3	75.4

ACTUAL SLOPE OF POLLUTANT CHARACTERISTIC CURVE

DATE	CO PPM/%	NO PPM/%	NO2 PPM/%	TPM MG/M**3/%	RCD MG/M**3/%	SO4 MG/M**3/%	SO2 PPM/%	AQI AQI/%
1/10	6.2	64.4	2.3	35.0	17.5	3.6	7.6	46.3
1/11	11.1	83.6	6.0	26.6	11.4	3.6	7.6	37.4
1/12	13.2	91.8	5.4	34.7	16.0	3.6	7.6	46.0
1/13	31.0	60.7	14.9	25.9	12.4	3.6	7.6	42.4
AVG	14.4	75.5	6.6	31.1	14.6	3.6	7.6	43.4

DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING,%

DATE	CO %	NO %	NO2 %	TPM %	RCD %	SO4 %	SO2 %	AQI %
1/10	-1828.6	7.5	-415.7	66.0	72.8	33.2	37.1	79.4
1/11	-934.3	28.0	-99.7	54.7	57.7	32.3	36.3	74.2
1/12	-815.7	34.4	-121.2	65.3	69.8	32.3	36.3	79.1
1/13	-290.1	0.3	18.9	53.3	61.0	32.0	36.0	77.1
AVG	-735.8	20.3	-81.0	61.3	67.1	32.5	36.5	77.8

AQI CHARACTERISTIC CURVE PARAMETERS

AT AVERAGE TWA CO2,% = 0.069

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.02	0.66	0.50	13.90
NO	0.21	6.96	5.24	1.33
NO2	0.13	6.12	4.62	1.51
RCD	1.88	62.35	47.01	0.15
SO4	0.46	15.18	11.45	0.61
SO2	0.26	8.72	6.58	1.06
TOTAL	3.02	100.00	75.40	

AT MAXIMUM TWA CO2,% = 0.031

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.02	0.66	0.53	13.90
NO	0.24	6.96	6.11	1.33
NO2	0.22	6.12	5.33	1.51
RCD	2.19	62.35	54.79	0.15
SO4	0.53	15.18	13.34	0.61
SO2	0.31	8.72	7.66	1.06
TOTAL	3.52	100.00	87.88	

FREQUENCY AT WHICH CO2,% EXCEEDS CO2 AT AQI = 4 : 0

MAXIMUM ALLOWABLE CO2,% AT AQI = 4 : 0.092
EQUIVALENT CFM/BHP : 215.67

ORDER OF POLLUTANTS ACCORDING TO AQI
(LEAST TO MOST CRITICAL)
CO NO2 NO SO2 SO4 RCD

ORDER OF POLLUTANTS ACCORDING TO TLV OR ASSUMED LIMIT
(LEAST TO MOST CRITICAL)
CO NO2 NO SO4 SO2 RCD AQI

POLLUTANT OR INDEX	TLV OR LIMIT	TYPICAL AMBIENT SLOPE	LIMITING AMBIENT SLOPE AT 0.15% CO2	DETERIORATION FACTOR
CO	50.00	14.39	333.33	23.17
NO	25.00	75.47	166.67	2.21
NO2	5.00	6.64	33.33	5.02
RCD	2.00	14.63	13.33	0.91
SO4	1.00	3.56	6.67	1.87
SO2	2.00	7.57	13.33	1.76
AQI	4.00	43.40	26.67	0.61
CO/50 +NO/25	1.00	0.60	6.67	11.12

DESCRIPTION: THIS SECTION TABULATES THE FOLLOWING INFORMATION FOR EACH POLLUTANT:

* LHD
* DIFFERENCE
* % DIFFERENCE
* SLOPES OF POLLUTANTS
* CO2,% AT TLV
* % OF POLLUTANT'S TLV
* DESIRED CONTROL EFFICIENCY

PROJECT: LITTLE STOBIE MINE

DATE : JANUARY 23 - JANUARY 26,1984

FUEL INFORMATION (ASSUMED) :

BSFC = 0.440

DATE	CONVERSION OF FUEL TO SO4(%)	PERCENT SULFUR
1/23	2.50	0.230
1/24	2.50	0.230
1/25	2.50	0.230

AQI = CO/50 + NO/25 + RCD/2 + 1.5(SO2/3 + RCD/2) + 1.2(NO2/3 + RCD/2)

1979 ACGIH TLV'S AND ASSUMED LIMITS

POLLUTANT	LIMIT	BASIS OF LIMIT
CO	50.0 PPM	1979 ACGIH TLV*
NO	25.0 PPM	1979 ACGIH TLV
NO2	5.0 PPM	1979 ACGIH TLV
TPM	5.0 MG/M**3	ASSUMED
RCD	2.0 MG/M**3	ASSUMED**
SO4	1.0 MG/M**3	1979 ACGIH TLV
SO2	2.0 PPM	1979 ACGIH TLV

* ONTARIO REGULATIONS
** COAL STANDARD

POLLUTANT CONCENTRATIONS

LHD

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.138	3.50	5.17	0.95	1.71
1/24	0.127	3.60	6.97	0.93	1.89
1/25	0.120	2.61	3.63	1.39	1.85
AVG	0.128	3.24	5.26	1.09	1.82

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.80	0.91	0.08	0.76	2.68
1/24	0.61	1.28	0.07	0.68	2.32
1/25	0.57	1.28	0.06	0.52	2.17
AVG	0.66	1.16	0.07	0.65	2.39

POLLUTANT CONCENTRATIONS

UPSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.061	2.00	0.42	0.34	0.20
1/24	0.059	2.00	0.32	0.60	0.17
1/25	0.068	1.27	0.96	0.57	0.14
AVG	0.063	1.76	0.57	0.50	0.17

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.02	0.18	0	0	0.22
1/24	0.06	0.11	0	0	0.36
1/25	0.06	0.08	0	0	0.36
AVG	0.05	0.13	0	0	0.31

DIFFERENCE, LHD - UPSTREAM

CONCENTRATION

DATE	CO2,%	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.077	1.50	4.75	0.60	1.51
1/24	0.068	1.60	6.66	0.34	1.72
1/25	0.052	1.34	2.67	0.82	1.72
AVG	0.066	1.48	4.69	0.59	1.65

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.78	0.73	0.02	0.76	2.44
1/24	0.55	1.17	0.07	0.68	1.92
1/25	0.51	1.20	0.06	0.52	1.77
AVG	0.61	1.03	0.07	0.65	2.04

SLOPES OF POLLUTANT VS. CO2,%

LHD - UPSTREAM

DATE	CO2,%	CO, PPM/%	NO, PPM/%	NO2, PPM/%	TPM, MG/M**3/%
1/23	1.000	19.48	61.73	7.34	19.57
1/24	1.000	23.53	97.90	4.96	25.29
1/25	1.000	25.37	51.35	15.71	33.00
AVG	1.000	22.56	71.47	8.92	25.09

DATE	RCD, MG/M**3/%	TPM-RCD, MG/M**3/%	SO4, MG/M**3/%	SO2, PPM/%	AQI, AQI/%
1/23	10.12	9.45	1.08	9.93	31.67
1/24	8.09	17.21	1.08	9.93	28.69
1/25	9.87	23.13	1.08	9.93	34.06
AVG	9.35	15.74	1.08	9.93	31.14

CO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	2.6	50.0	3.0	19.5	113.9	-484.7
1/24	2.1	50.0	3.2	23.5	113.4	-381.9
1/25	1.9	50.0	2.7	25.9	115.7	-347.5
AVG	2.2	50.0	3.0	22.6	114.3	-406.7

NO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.4	25.0	19.0	61.7	56.9	7.7
1/24	0.3	25.0	26.6	97.9	56.7	42.1
1/25	0.5	25.0	10.7	51.3	57.9	-12.7
AVG	0.3	25.0	18.8	71.5	57.2	20.0

NO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.6	5.0	12.1	7.6	11.4	-45.2
1/24	1.0	5.0	6.7	5.0	11.3	-128.8
1/25	0.3	5.0	16.3	15.7	11.6	26.3
AVG	0.6	5.0	11.7	8.9	11.4	-28.1

TPM CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.3	5.0	30.1	19.6	11.4	41.3
1/24	0.2	5.0	34.4	25.3	11.3	55.2
1/25	0.2	5.0	34.0	33.0	11.6	64.9
AVG	0.2	5.0	33.0	25.1	11.4	54.4

RCD CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.2	2.0	38.9	10.1	4.6	55.0
1/24	0.2	2.0	27.5	8.1	4.5	43.9
1/25	0.2	2.0	25.6	9.9	4.6	53.1
AVG	0.2	2.0	30.7	9.4	4.6	51.1

SO4 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.9	1.0	6.3	1.1	2.3	-111.3
1/24	0.9	1.0	7.3	1.1	2.3	-110.4
1/25	0.9	1.0	5.6	1.1	2.3	-114.8
AVG	0.9	1.0	7.1	1.1	2.3	-112.1

SO2 CHARACTERISTIC C[illegible] PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.2	2.0	38.2	9.9	4.6	54.1
1/24	0.2	2.0	33.8	9.9	4.5	54.3
1/25	0.2	2.0	25.8	9.9	4.6	53.4
AVG	0.2	2.0	32.6	9.9	4.6	53.9

AQI CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, AQI	CONC. AS % OF TLV	ACTUAL SLOPE, AQI/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, AQI/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.1	4.0	51.0	31.7	9.1	71.2
1/24	0.1	4.0	46.	28.3	9.1	67.9
1/25	0.1	4.0	44.3	34.1	9.3	72.6
AVG	0.1	4.0	51.1	31.1	9.1	70.6

CO2, % AT TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/23	2.567	0.405	0.637	0.255	0.198	0.928	0.201	0.126
1/24	2.125	0.255	1.009	0.198	0.247	0.928	0.201	0.141
1/25	1.933	0.487	0.318	0.152	0.203	0.928	0.201	0.117
AVG	2.216	0.350	0.560	0.199	0.214	0.928	0.201	0.128

CONCENTRAION AS % OF POLLUTANT'S TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/23	3.0	19.0	12.1	30.1	38.9	8.3	38.2	61.0
1/24	3.2	26.6	6.7	34.4	27.5	7.3	33.8	48.1
1/25	2.7	10.7	16.3	34.3	25.6	5.6	25.8	44.3
AVG	3.0	18.8	11.7	33.0	30.7	7.1	32.6	51.1

ACTUAL SLOPE OF POLLUTANT CHARACTERISTIC CURVE

DATE	CO PPM/%	NO PPM/%	NO2 PPM/%	TPM MG/M**3/%	RCD MG/M**3/%	SO4 MG/M**3/%	SO2 PPM/%	AQI AQI/%
1/23	19.5	61.7	7.8	19.6	10.1	1.1	9.9	31.7
1/24	23.5	97.9	5.0	25.3	8.1	1.1	9.9	28.3
1/25	25.9	51.3	15.7	33.0	9.9	1.1	9.9	34.1
AVG	22.6	71.5	8.9	25.1	9.4	1.1	9.9	31.1

DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING,%

DATE	CO %	NO %	NO2 %	TPM %	RCD %	SO4 %	SO2 %	AQI %
1/23	-484.7	7.7	-45.2.	41.8	55.0	-111.3	54.1	71.2
1/24	-381.9	42.1	-128.8	55.2	43.9	-110.4	54.3	67.9
1/25	-347.5	-12.7	26.3	64.9	53.1	-114.8	53.4	72.8
AVG	-406.7	20.0	-28.1	54.4	51.1	-112.1	53.9	70.6

AQI CHARACTERISTIC CURVE PARAMETERS

AT AVERAGE TWA CO2,% = 0.066

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.03	1.45	0.74	8.86
NO	0.19	9.18	4.69	1.40
NO2	0.23	11.46	5.86	1.12
RCD	1.14	55.56	28.40	0.23
SO4	0.13	6.40	3.27	2.01
SO2	0.33	15.94	8.15	0.81
TOTAL	2.04	100.00	51.11	

AT MAXIMUM TWA CO2,% = 0.077

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.03	1.45	0.87	8.86
NO	0.22	9.13	5.50	1.40
NO2	0.27	11.46	6.87	1.12
RCD	1.33	55.56	33.30	0.23
SO4	0.15	6.40	3.84	2.01
SO2	0.33	15.94	9.56	0.81
TOTAL	2.40	100.00	59.94	

FREQUENCY AT WHICH CO2,% EXCEEDS CO2 AT AQI = 4 : 0

MAXIMUM ALLOWABLE CO2,% AT AQI = 4 : 0.128
EQUIVALENT CFM/BHP : 154.74

ORDER OF POLLUTANTS ACCORDING TO AQI
(LEAST TO MOST CRITICAL)
CO SO4 NO NO2 SO2 RCD

ORDER OF POLLUTANTS ACCORDING TO TLV OR ASSUMED LIMIT
(LEAST TO MOST CRITICAL)

CO SO4 NO2 NO RCD SO2 AQI

POLLUTANT OR INDEX	TLV OR LIMIT	TYPICAL AMBIENT SLOPE	LIMITING AMBIENT SLOPE AT 0.15% CO2	DETERIORATION FACTOR
CO	50.00	22.56	333.33	14.77
NO	25.00	71.47	166.67	2.33
NO2	5.00	8.92	33.33	3.74
RCD	2.00	9.35	13.33	1.43
SO4	1.00	1.08	6.67	6.18
SO2	2.00	9.93	13.33	1.34
AQI	4.00	31.14	26.67	0.86
CO/50 +NO/25	1.00	0.92	6.67	7.23

APPENDIX 4

Analyzed Data for Heading Location

Weeks 1 and 2

TKPM BLANK INFORMATION

BLANK	INITIAL FILTER WEIGHT MG	FINAL FILTER WEIGHT MG	DIFFERENCE MG
14	03.090	03.090	0
38	02.820	02.830	0.010
39	02.900	02.910	0.010
40	03.470	03.480	0.010
AVG			0.008
STD DEV			0.005

CARBON BLANK INFORMATION

BLANK	CARBON MG
14	0.015
38	0.010
39	0.014
40	0.008
AVG	0.012
STD DEV	0.003

HYDROGEN BLANK INFORMATION

BLANK	HYDROGEN MG
14	0.020
38	0.019
39	0.020
40	0.017
AVG	0.020
STD DEV	0.004

PARTICULATE MATTER INFORMATION

DATE	FILTER NUMBER	WEIGHT, MG INITIAL	WEIGHT, MG FINAL	DIFF., MG	CORR. DIFF., MG	RATE, LPM	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	EXPERIMENT TIME, HRS	TRPM, MG/M**3
1/12	22	01.920	03.300	1.380	1.373	4.750	8:56	11:20	4.067	1.184
							12:20	2: 0		
1/12	23	70.130	72.120	1.990	1.983	4.750	8:56	11:20	4.067	1.711
							12:20	2: 0		
	AVG									1.447
	STD DEV									0.372
1/13	28	03.470	04.970	1.500	1.492	4.750	1:15	5: 0	5.067	0.924
							5:20	7:15		
1/13	29	04.040	06.130	1.490	1.482	4.750	1:15	5: 0	5.067	0.918
							5:20	7:15		
	AVG									0.921
	STD DEV									0.004
1/23	43	69.560	70.870	1.310	1.303	4.750	8:35	11:13	4.633	0.986
							12:25	2:25		
1/23	47	05.080	06.460	1.380	1.372	4.750	8:35	11:13	4.633	1.059
							12:25	2:25		
	AVG									1.013
	STD DEV									0.037
1/24	36	07.000	08.450	1.450	1.442	4.750	9:15	11:28	4.167	1.215
							12:35	2:32		
1/24	41	70.490	72.200	1.710	1.702	4.750	9:15	11:28	4.167	1.434
							12:35	2:32		
	AVG									1.324
	STD DEV									0.155
1/25	1	68.060	69.060	1.000	1.593	4.750	9:15	11:28	4.167	1.341
							12:35	2:32		
1/25	10	60.710	62.320	1.610	1.603	4.750	9:15	11:28	4.167	1.349
							12:35	2:32		
	AVG									1.345
	STD DEV									0.006

DATE	FILTER NUMBER	CARBON/ MG	HYDROGEN/ MG	CORR. C/ MG	CORR. H/ MG	C+H/ MG	C+H/ MG/M**3
1/12	22	0.442	0.068	0.430	0.048	0.478	0.412
1/12	23	0.541	0.083	0.529	0.063	0.592	0.511
	AVG						0.462
	STD DEV						0.070
1/13	28	0.650	0.100	0.636	0.079	0.717	0.444
1/13	29	0.655	0.098	0.643	0.078	0.721	0.447
	AVG						0.445
	STD DEV						0.002
1/23	45	0.464	0.077	0.452	0.057	0.509	0.386
1/23	47	0.503	0.087	0.491	0.067	0.558	0.423
	AVG						0.404
	STD DEV						0.026
1/24	36	0.393	0.069	0.383	0.049	0.432	0.364
1/24	41	0.393	0.069	0.381	0.049	0.430	0.362
	AVG						0.363
	STD DEV						0.001
1/25	1	0.404	0.069	0.392	0.048	0.441	0.340
1/25	10	0.396	0.071	0.384	0.051	0.435	0.335
	AVG						0.338
	STD DEV						0.003

NO2

DATE	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	TIME, HRS	SAMPLER NO.	PPM-HRS	PPM	CORR. FOR TEMP, PPM	CORR. FOR TEMP & INSTR, PPM
1/10								
	9:47	1:10	3.383	1079	1.100	0.325	0.449	0.449
	9:47	1:10	3.383	1069	1.400	0.414	0.571	0.571
	9:47	1:10	3.383	1059	0.900	0.266	0.367	0.367
AVG								0.462
STD DEV								0.103
1/11								
	9:49	11:30	3.483	1081	1.900	0.545	0.753	0.753
	12:35	2:23						
	9:49	11:30	3.483	1111	2.000	0.574	0.792	0.792
	12:35	2:23						
	9:49	11:30	3.483	1037	2.600	0.746	1.030	1.030
	12:35	2:23						
AVG								0.858
STD DEV								0.150
1/12								
	8:50	11:20	4.067	1083	2.000	0.492	0.679	0.679
	12:20	2: 0						
	8:50	11:20	4.067	1093	1.600	0.443	0.611	0.611
	12:20	2: 0						
	8:50	11:20	4.067	1094	2.700	0.664	0.916	0.916
	12:20	2: 0						
AVG								0.735
STD DEV								0.160
1/13								
	1:15	5: 0	5.667	1124	2.800	0.494	0.682	0.682
	5:20	7:15						
	1:15	5: 0	5.667	1065	2.500	0.441	0.609	0.609
	5:20	7:15						
	1:15	5: 0	5.667	1045	3.600	0.635	0.877	0.877
	5:20	7:15						
AVG								0.722
STD DEV								0.136
1/23								
	8:55	11:13	4.033	1202	6.000	1.295	1.787	1.787
	12:25	2:25						

		8:35 12:25	11:13 2:25	4.633	1205	2.000	0.432	0.596	0.596
		8:35 12:25	11:13 2:25	4.633	1204	4.600	0.993	1.370	1.370
	Avg STD DEV								1.251 0.605
1/24									
		9:15 12:35	11:28 2:32	4.167	1220	2.400	0.576	0.795	0.795
		9:15 12:35	11:28 2:32	4.167	1222	2.300	0.552	0.762	0.762
	Avg STD DEV								0.778 0.023
1/25									
		8:44 12:32	11:20 2:29	4.550	1173	1.600	0.352	0.485	0.485
		8:44 12:32	11:20 2:29	4.550	1174	2.300	0.505	0.698	0.698
	Avg STD DEV								0.591 0.150
1/26									
		9: 0	11:24	2.300	1257	3.200	1.391	1.920	1.920
		9: 0	11:24	2.300	1258	0.900	0.391	0.540	0.540
		9: 0	11:24	2.300	1259	1.700	0.739	1.020	1.020
	Avg STD DEV								1.160 0.701

		NOX			NO		
DATE		SAMPLER NO.	PPM-HRS	PPM	NOX-AVG NO2, PPM	CORR. FOR TEMP, PPM	CORR. FOR TEMP & INSTR, PPM
1/10							
		1058	2.600	0.828	0.365	0.409	0.409
		1068	3.700	1.094	0.631	0.707	0.707
		1047	3.600	1.064	0.602	0.674	0.674
	AVG			0.995			0.597
	STD DEV			0.140			0.103
1/11							
		1070	16.600	4.766	3.907	4.376	4.376
		1119	17.200	4.938	4.079	4.569	4.569
	AVG			4.852			4.472
	STD DEV			0.122			0.136
1/12							
		1043	17.000	4.180	3.445	3.838	[illegible]
		1131	19.800	4.869	4.134	4.630	4.630
	AVG			4.525			4.244
	STD DEV			0.487			0.545
1/13							
		1095	21.600	3.812	3.089	3.460	3.460
		1116	22.000	3.882	3.160	3.539	3.539
		1056	23.200	4.094	3.372	3.776	3.776
	AVG			3.929			3.592
	STD DEV			0.147			0.165
1/23							
		1194	24.000	5.309	4.058	4.545	4.545
		1196	23.800	5.137	3.886	4.352	4.352
	AVG			5.223			4.449
	STD DEV			0.122			0.137
1/24							
		1231	25.200	6.048	5.270	5.902	5.902
		1227	28.000	6.720	5.942	6.655	6.655
		1225	29.200	7.008	6.230	6.977	6.977

	Avg			6.592			6.511
	STD DEV			0.493			0.552
1/25							
		1177	17.100	3.758	3.167	3.547	3.547
		1181	20.000	4.396	3.804	4.261	4.261
		1178	23.000	5.055	4.464	4.999	4.999
	Avg			4.403			4.269
	STD DEV			0.648			0.726
1/26							
		1246	5.500	2.391	1.231	1.379	1.379
		1239	8.100	3.522	2.362	2.045	2.045
	Avg			2.957			2.012
	STD DEV			0.799			0.895

	TEMPERATURE CORRECTION FACTOR	INSTRUMENT CORRECTION FACTOR
NO2	1.360	1.000
NO	1.120	1.000

DESCRIPTION: THIS SECTION TABULATES THE FOLLOWING INFORMATION FOR EACH POLLUTANT:

* LHD
* DIFFERENCE
* % DIFFERENCE
* SLOPES OF POLLUTANTS
* CO2,% AT TLV
* % OF POLLUTANT'S TLV
* DESIRED CONTROL EFFICIENCY

PROJECT: LITTLE STOBIE MINE

DATE : JANUARY 10 - JANUARY 13,1984

FUEL INFORMATION (ASSUMED) :

BSFC = 0.440

DATE	CONVERSION OF FUEL TO SO4(%)	PERCENT SULFUR
1/10	10.00	0.190
1/11	10.00	0.190
1/12	10.00	0.190
1/13	10.00	0.190

$$AQI = CO/50 + NO/25 + RCD/2 + 1.5(SO2/3 + RCD/2) + 1.2(NO2/3 + RCD/2)$$

1979 ACGIH TLV'S AND ASSUMED LIMITS

POLLUTANT	LIMIT	BASIS OF LIMIT
CO	50.0 PPM	1979 ACGIH TLV*
NO	25.0 PPM	1979 ACGIH TLV
NO2	5.0 PPM	1979 ACGIH TLV
TPM	5.0 MG/M**3	ASSUMED
RCD	2.0 MG/M**3	ASSUMED**
SO4	1.0 MG/M**3	1979 ACGIH TLV
SO2	2.0 PPM	1979 ACGIH TLV

* ONTARIO REGULATIONS
** COAL STANDARD

POLLUTANT CONCENTRATIONS

HEADING

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10		2.20	0.60	0.46	
1/11	0.130	2.00	4.47	0.86	
1/12	0.146	3.00	3.59	0.73	1.45
1/13	0.144	3.20	4.45	0.72	0.92
AVG	0.140	2.60	3.28	0.69	1.18

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10					
1/11			0.16	0.34	
1/12	0.46	0.98	0.22	0.46	1.99
1/13	0.44	0.48	0.20	0.43	1.95
AVG	0.45	0.73	0.19	0.41	1.86

POLLUTANT CONCENTRATIONS

UPSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10	0.080	2.80	0.19	0.53	0.00
1/11	0.085	1.30	0.30	0.55	0.07
1/12	0.085	2.00	0.46	0.40	0.10
1/13	0.087	1.60	0.59	0.39	0.04
AVG	0.084	1.92	0.38	0.47	0.05

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	0.04	-0.04	0	0	0.32
1/11	0.05	0.03	0	0	0.31
1/12	0.08	0.02	0	0	0.30
1/13	0.06	-0.01	0	0	0.28
AVG	0.06	-0.00	0	0	0.30

DIFFERENCE, HEADING - UPSTREAM

CONCENTRATION

DATE	CO2,%	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10		-0.60	0.41	-0.07	
1/11	0.045	0.70	4.17	0.31	
1/12	0.061	1.00	3.13	0.34	1.35
1/13	0.057	1.60	3.86	0.33	0.88
AVG	0.056	0.68	2.89	0.23	1.13

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10					
1/11			0.16	0.34	
1/12	0.38	0.97	0.22	0.46	1.62
1/13	0.39	0.49	0.20	0.43	1.63
AVG	0.40	0.73	0.19	0.41	1.52

SLOPES OF POLLUTANT VS. CO2,%

HEADING-UPSTREAM

DATE	CO2,%	CO, PPM/%	NO, PPM/%	NO2, PPM/%	TPM, MG/M**3/%
1/10					
1/11	1.000	15.56	92.71	6.93	
1/12	1.000	16.39	51.39	5.56	22.15
1/13	1.000	28.07	67.67	5.77	15.37
AVG	1.000	20.25	68.49	6.01	20.49

DATE	RCD, MG/M**3/%	TPM-RCD, MG/M**3/%	SO4, MG/M**3/%	SO2, PPM/%	AQI, AQI/%
1/10					
1/11			3.56	7.57	
1/12	6.30	15.85	3.56	7.57	26.63
1/13	6.79	8.58	3.56	7.57	28.51
AVG	7.10	13.40	3.56	7.57	27.90

CO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	83.3	50.0	-1.2	0.6	119.0	-19741.3
1/11	3.2	50.0	1.4	15.6	120.5	-674.5
1/12	3.1	50.0	2.0	16.4	120.5	-634.9
1/13	1.8	50.0	3.2	28.1	121.1	-331.3
AVG	2.5	50.0	2.2	20.2	120.3	-494.0

NO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	-61.1	25.0	[illegible]	-0.4	59.5	14653.5
1/11	0.3	25.0	[illegible]	92.7	60.2	35.0
1/12	0.5	25.0	12.5	51.4	60.2	-17.2
1/13	0.4	25.0	15.4	67.7	60.5	10.5
AVG	0.4	25.0	14.9	68.5	60.1	12.2

NO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	75.8	5.0	-1.3	0.1	11.9	-17937.5
1/11	0.7	5.0	6.2	6.9	12.0	-73.8
1/12	0.9	5.0	6.8	5.6	12.0	-116.8
1/13	0.9	5.0	6.6	5.8	12.1	-109.7
AVG	0.8	5.0	6.5	6.0	12.0	-100.0

TPM CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10						
1/11						
1/12	0.2	5.0	27.0	22.1	12.0	45.6
1/13	0.3	5.0	17.5	15.4	12.1	21.2
AVG	0.2	5.0	22.3	20.5	12.0	41.3

RCD CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10						
1/11						
1/12	0.3	2.0	19.2	6.3	4.8	23.4
1/13	0.3	2.0	19.3	6.8	4.8	28.7
AVG	0.3	2.0	19.3	7.1	4.8	32.2

SO4 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10						
1/11	0.3	1.0	16.0	3.6	2.4	32.3
1/12	0.3	1.0	21.7	3.6	2.4	32.3
1/13	0.3	1.0	20.3	3.6	2.4	32.0
AVG	0.3	1.0	19.4	3.6	2.4	32.5

SO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10						
1/11	0.3	2.0	17.0	7.6	4.8	36.3
1/12	0.3	2.0	23.1	7.6	4.8	36.3
1/13	0.3	2.0	21.6	7.6	4.8	36.0
AVG	0.3	2.0	20.6	7.6	4.8	36.5

AQI CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, AQI	CONC. AS % OF TLV	ACTUAL SLOPE, AQI/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, AQI/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10						
1/11						
1/12	0.2	4.0	40.6	26.6	9.6	63.8
1/13	0.1	4.0	40.6	28.5	9.7	66.0
AVG	0.1	4.0	40.6	29.9	9.6	67.8

CO2,% AT TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/10	83.333	-61.125	75.758					
1/11	3.214	0.270	0.721			0.281	0.264	
1/12	3.050	0.486	0.900	0.226	0.318	0.281	0.264	0.150
1/13	1.781	0.369	0.866	0.325	0.295	0.281	0.264	0.140
AVG	2.470	0.365	0.832	0.244	0.282	0.281	0.264	0.134

CONCENTRAION AS % OF POLLUTANT'S TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/10	-1.2	1.6	-1.3					
1/11	1.4	16.7	6.2			16.0	17.0	
1/12	2.0	12.5	6.8	27.0	19.2	21.7	23.1	40.6
1/13	3.2	15.4	6.6	17.5	19.3	20.3	21.6	40.6
AVG	2.2	14.9	6.5	22.3	19.3	19.4	20.6	40.6

ACTUAL SLOPE OF POLLUTANT CHARACTERISTIC CURVE

DATE	CO PPM/%	NO PPM/%	NO2 PPM/%	TPM MG/M**3/%	RCD MG/M**3/%	SO4 MG/M**3/%	SO2 PPM/%	AQI AQI/%
1/10	0.6	-0.4	0.1					
1/11	15.6	92.7	6.9			3.6	7.6	
1/12	16.4	51.4	5.6	22.1	6.3	3.6	7.6	26.6
1/13	28.1	67.7	5.8	15.4	6.8	3.6	7.6	28.5
AVG	20.2	68.5	6.0	20.5	7.1	3.6	7.6	29.9

DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING,%

DATE	CO %	NO %	NO2 %	TPM %	RCD %	SO4 %	SO2 %	AQI %
1/10	-19741.3	14653.5	-17937.5					
1/11	-674.5	35.0	-73.8			32.3	36.3	
1/12	-634.9	-17.2	-116.8	45.6	23.4	32.3	36.3	63.8
1/13	-331.3	10.5	-109.7	21.2	28.7	32.0	36.0	66.0
AVG	-494.0	12.2	-100.0	41.3	32.2	32.5	36.5	67.8

AQI CHARACTERISTIC CURVE PARAMETERS

AT AVERAGE TWA CO2,% = 0.056

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.02	1.39	0.56	9.88
NO	0.15	9.43	3.82	1.46
NO2	0.13	8.28	3.35	1.66
RCD	0.73	45.18	18.29	0.30
S04	0.37	22.68	9.18	0.61
S02	0.21	13.03	5.28	1.06
TOTAL	1.62	100.00	40.49	

AT MAXIMUM TWA CO2,% = 0.061

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.02	1.39	0.62	9.88
NO	0.17	9.43	4.18	1.46
NO2	0.15	8.28	3.67	1.66
RCD	0.80	45.18	20.02	0.30
S04	0.40	22.68	10.05	0.61
S02	0.23	13.03	5.77	1.06
TOTAL	1.77	100.00	44.30	

FREQUENCY AT WHICH CO2,% EXCEEDS CO2 AT AQI = 4 : 0

MAXIMUM ALLOWABLE CO2,% AT AQI = 4 : 0.134
EQUIVALENT CFM/BHP : 148.61

ORDER OF POLLUTANTS ACCORDING TO AQI
(LEAST TO MOST CRITICAL)
CO NO2 NO S02 S04 RCD

ORDER OF POLLUTANTS ACCORDING TO TLV OR ASSUMED LIMIT
(LEAST TO MOST CRITICAL)

CO NO2 NO RCD S04 S02 AQI

POLLUTANT OR INDEX	TLV OR LIMIT	TYPICAL AMBIENT SLOPE	LIMITING AMBIENT SLOPE AT 0.15% CO2	DETERIORATION FACTOR
CO	50.00	20.25	333.33	16.46
NO	25.00	68.49	166.67	2.43
NO2	5.00	6.01	33.33	5.54
RCD	2.00	7.10	13.33	1.88
SO4	1.00	3.56	6.67	1.87
SO2	2.00	7.57	13.33	1.76
AQI	4.00	29.90	26.67	0.89
CO/50 +NO/25	1.00	0.51	6.67	12.96

DESCRIPTION: THIS SECTION TABULATES THE FOLLOWING INFORMATION FOR EACH POLLUTANT:

* LHD
* DIFFERENCE
* % DIFFERENCE
* SLOPES OF POLLUTANTS
* CO2,% AT TLV
* % OF POLLUTANT'S TLV
* DESIRED CONTROL EFFICIENCY

PROJECT: LITTLE STOBIE MINE

DATE : JANUARY 23 - JANUARY 26,1984

FUEL INFORMATION (ASSUMED) :

BSFC = 0.440

DATE	CONVERSION OF FUEL TO SO4(%)	PERCENT SULFUR
1/23	2.50	0.230
1/24	2.50	0.230
1/25	2.50	0.230

$$AQI = CO/50 + NO/25 + RCD/2 + 1.5(SO2/3 + RCD/2) + 1.2(NO2/3 + RCD/2)$$

1979 ACGIH TLV'S AND ASSUMED LIMITS

POLLUTANT	LIMIT	BASIS OF LIMIT
CO	50.0 PPM	1979 ACGIH TLV*
NO	25.0 PPM	1979 ACGIH TLV
NO2	5.0 PPM	1979 ACGIH TLV
TPM	5.0 MG/M**3	ASSUMED
RCD	2.0 MG/M**3	ASSUMED**
SO4	1.0 MG/M**3	1979 ACGIH TLV
SO2	2.0 PPM	1979 ACGIH TLV

* ONTARIO REGULATIONS
** CCAL STANDARD

POLLUTANT CONCENTRATIONS

HEADING

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.135	3.60	4.45	1.25	1.01
1/24	0.135	3.70	6.51	0.78	1.32
1/25	0.114	2.43	3.14	0.88	1.34
AVG	0.128	3.24	4.70	0.97	1.23

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.40	0.61	0.08	0.73	2.01
1/24	0.36	0.96	0.08	0.75	1.85
1/25	0.34	1.01	0.05	0.46	1.47
AVG	0.37	0.86	0.07	0.65	1.78

POLLUTANT CONCENTRATIONS

UPSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.061	2.00	0.42	0.34	0.20
1/24	0.059	2.00	0.32	0.60	0.17
1/25	0.068	1.27	0.96	0.57	0.14
AVG	0.063	1.76	0.57	0.50	0.17

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.02	0.18	0	0	0.22
1/24	0.06	0.11	0	0	0.36
1/25	0.06	0.08	0	0	0.36
AVG	0.05	0.13	0	0	0.31

DIFFERENCE, HEADING - UPSTREAM

CONCENTRATION

DATE	CO2,%	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.074	1.60	4.03	0.91	0.61
1/24	0.076	1.70	6.19	0.18	1.15
1/25	0.046	1.16	2.18	0.30	1.21
AVG	0.065	1.49	4.13	0.46	1.06

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.38	0.43	0.08	0.73	1.78
1/24	0.30	0.35	0.08	0.75	1.44
1/25	0.28	0.93	0.05	0.46	1.07
AVG	0.32	0.73	0.07	0.65	1.43

SLOPES OF POLLUTANT VS. CO2,%

HEADING-UPSTREAM

DATE	CO2,%	CO, PPM/%	NO, PPM/%	NO2, PPM/%	TPM, MG/M**3/%
1/23	1.000	21.62	54.43	12.27	10.93
1/24	1.000	22.37	81.50	2.37	15.14
1/25	1.000	25.22	47.39	6.59	26.24
AVG	1.000	22.76	63.28	7.10	16.16

DATE	RCD, MG/M**3/%	TPM-RCD, MG/M**3/%	SO4, MG/M**3/%	SO2, PPM/%	AQI, AQI/%
1/23	5.15	5.73	1.08	9.93	24.00
1/24	4.00	11.14	1.08	9.93	19.01
1/25	6.11	20.13	1.08	9.93	23.29
AVG	4.93	11.23	1.08	9.93	21.90

CO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	2.3	50.0	3.2	21.6	113.9	-426.8
1/24	2.2	50.0	3.4	22.4	113.4	-406.9
1/25	2.0	50.0	2.3	25.2	115.7	-359.0
AVG	2.2	50.0	3.0	22.8	114.3	-402.4

NO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.5	25.0	16.1	54.4	56.9	-4.6
1/24	0.3	25.0	24.8	81.5	56.7	30.4
1/25	0.5	25.0	8.7	47.4	57.9	-22.1
AVG	0.4	25.0	16.5	63.3	57.2	9.7

NO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.4	5.0	18.2	12.3	11.4	7.2
1/24	2.1	5.0	3.6	2.4	11.3	-378.7
1/25	0.8	5.0	6.1	6.6	11.6	-75.7
AVG	0.7	5.0	9.3	7.1	11.4	-61.1

TPM CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.5	5.0	16.2	10.9	11.4	-4.2
1/24	0.3	5.0	27.0	15.1	11.3	25.1
1/25	0.2	5.0	24.[illegible]	26.2	11.6	55.9
AVG	0.3	5.0	21.1	16.2	11.4	29.2

RCD CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.4	2.0	19.0	5.1	4.6	11.5
1/24	0.5	2.0	15.2	4.0	4.5	-13.4
1/25	0.3	2.0	14.1	6.1	4.6	24.2
AVG	0.4	2.0	16.1	4.9	4.6	7.2

SO4 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.9	1.0	8.0	1.1	2.3	-111.3
1/24	0.9	1.0	8.2	1.1	2.3	-110.4
1/25	0.9	1.0	5.0	1.1	2.3	-114.8
AVG	0.9	1.0	7.0	1.1	2.3	-112.1

SO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THRCUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.2	2.0	36.7	9.9	4.6	54.1
1/24	0.2	2.0	37.7	9.9	4.5	54.3
1/25	0.2	2.0	22.8	9.9	4.6	53.4
AVG	0.2	2.0	32.4	9.9	4.6	53.9

AQI CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, AQI	CONC. AS % OF TLV	ACTUAL SLOPE, AQI/%CO2	SLOPE THAT PASSES THRCUGH TLV AT 0.5%-BG CO2, AQI/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.2	4.0	44.4	24.0	9.1	62.0
1/24	0.2	4.0	36.1	19.0	9.1	52.3
1/25	0.2	4.0	26.8	23.3	9.3	60.3
AVG	0.2	4.0	35.8	21.9	9.1	58.2

CO2, % AT TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/23	2.313	0.459	0.407	0.457	0.388	0.928	0.201	0.167
1/24	2.235	0.307	2.111	0.330	0.500	0.928	0.201	0.210
1/25	1.983	0.528	0.759	0.191	0.327	0.928	0.201	0.172
AVG	2.197	0.395	0.705	0.309	0.406	0.928	0.201	0.183

CONCENTRAION AS % OF POLLUTANT'S TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/23	3.2	16.1	18.2	16.2	19.0	8.0	36.7	44.4
1/24	3.4	24.8	3.6	23.0	15.2	8.2	37.7	36.1
1/25	2.3	8.7	6.1	24.1	14.1	5.0	22.8	26.8
AVG	3.0	16.5	9.3	21.1	16.1	7.0	32.4	35.8

ACTUAL SLOPE OF POLLUTANT CHARACTERISTIC CURVE

DATE	CO PPM/%	NO PPM/%	NO2 PPM/%	TPM MG/M**3/%	RCD MG/M**3/%	SO4 MG/M**3/%	SO2 PPM/%	AQI AQI/%
1/23	21.6	54.4	12.3	[illegible].9	5.1	1.1	9.9	24.0
1/24	22.4	81.5	2.4	[illegible].1	4.0	1.1	9.9	19.0
1/25	25.2	47.4	6.6	26.2	6.1	1.1	9.9	23.3
AVG	22.8	63.3	7.1	16.2	4.9	1.1	9.9	21.9

DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING,%

DATE	CO %	NO %	NO2 %	TPM %	RCD %	SO4 %	SO2 %	AQI %
1/23	-426.8	-4.6	7.2	-4.2	11.5	-111.3	54.1	62.0
1/24	-406.9	30.4	-378.7	25.1	-13.4	-110.4	54.3	52.3
1/25	-359.0	-22.1	-75.7	55.9	24.2	-114.8	53.4	60.3
AVG	-402.4	9.7	-61.1	29.2	7.2	-112.1	53.9	58.2

AQI CHARACTERISTIC CURVE PARAMETERS

AT AVERAGE TWA CO2,% = 0.065

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.03	2.08	0.74	8.79
NO	0.17	11.56	4.13	1.58
NO2	0.19	12.96	4.64	1.41
RCD	0.60	41.63	14.89	0.44
SO4	0.13	9.11	3.26	2.01
SO2	0.32	22.66	8.11	0.81
TOTAL	1.43	100.00	35.77	

AT MAXIMUM TWA CO2,% = 0.076

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.03	2.08	0.86	8.79
NO	0.19	11.56	4.81	1.58
NO2	0.22	12.96	5.39	1.41
RCD	0.69	41.63	17.32	0.44
SO4	0.15	9.11	3.79	2.01
SO2	0.38	22.66	9.43	0.81
TOTAL	1.66	100.00	41.61	

FREQUENCY AT WHICH CO2,% EXCEEDS CO2 AT AQI = 4 : 0

MAXIMUM ALLOWABLE CO2,% AT AQI = 4 : 0.183
EQUIVALENT CFM/BHP : 108.84

ORDER OF POLLUTANTS ACCORDING TO AQI
(LEAST TO MOST CRITICAL)
CO SO4 NO NO2 SO2 RCD

ORDER OF POLLUTANTS ACCORDING TO TLV OR ASSUMED LIMIT
(LEAST TO MOST CRITICAL)

CO SO4 NO2 RCD NO SO2 AQI

POLLUTANT OR INDEX	TLV OR LIMIT	TYPICAL AMBIENT SLOPE	LIMITING AMBIENT SLOPE AT 0.15% CO2	DETERIORATION FACTOR
CO	50.00	22.76	333.33	14.65
NO	25.00	63.28	166.67	2.63
NO2	5.00	7.10	33.33	4.70
RCD	2.00	4.93	13.33	2.71
SO4	1.00	1.08	6.67	6.18
SO2	2.00	9.93	13.33	1.34
AQI	4.00	21.90	26.67	1.22
CO/50 +NO/25	1.00	0.93	6.67	7.17

APPENDIX 5

Analyzed Data for Downstream Location

Weeks 1 and 2

TRPM BLANK INFORMATION

BLANK	INITIAL FILTER WEIGHT MG	FINAL FILTER WEIGHT MG	DIFFERENCE MG
14	63.090	63.090	0
38	62.820	62.830	0.010
39	62.900	62.910	0.010
40	63.470	63.480	0.010
AVG			0.008
STD DEV			0.005

CARBON BLANK INFORMATION

BLANK	CARBON, MG
14	0.015
38	0.010
39	0.014
40	0.006
AVG	0.012
STD DEV	0.003

HYDROGEN BLANK INFORMATION

BLANK	HYDROGEN, MG
14	0.020
38	0.019
39	0.024
40	0.017
AVG	0.020
STD DEV	0.004

DATE	FILTER NUMBER	WEIGHT, MG INITIAL	WEIGHT, MG FINAL	DIFF., MG	CORR. DIFF., MG	RATE, LPM	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	EXPERIMENT TIME, HRS	TRPM, MG/M**3
1/10	5	59.550	60.570	1.020	1.012	4.750	8:47	1: 1	4.233	0.839
1/10	6	62.570	63.590	1.020	1.012	4.750	8:47	1: 1	4.233	0.839
AVG										0.839
STD DEV										0
1/11	16	64.540	66.020	1.480	1.472	4.750	8:23 9:10 12:35	8:35 11:30 2:30	4.450	1.161
1/11	17	61.080	62.760	1.680	1.672	4.750	8:23 9:10 12:35	8:35 11:30 2:30	4.450	1.319
AVG										1.240
STD DEV										0.112
1/12	24	61.790	63.820	2.030	2.022	4.750	9: 0 12:20	11:20 2: 5	4.083	1.738
1/12	25	68.620	70.750	2.130	2.123	4.750	9: 0 12:20	11:20 2: 5	4.083	1.824
AVG										1.781
STD DEV										0.061
1/13	26	68.710	70.650	1.940	1.933	4.750	1:25 5:20	5: 0 7:10	5.417	1.252
1/13	30	63.760	65.510	1.750	1.742	4.750	1:25 5:20	5: 0 7:10	5.417	1.129
AVG										1.190
STD DEV										0.087
1/23	44	69.730	71.490	1.760	1.753	4.750	8:45 12:20	11:17 2:15	4.450	1.382
1/23	37	63.910	65.420	1.510	1.502	4.650	8:45 12:20	11:17 2:15	4.450	1.210
AVG										1.296
STD DEV										0.121
1/24	50	63.210	64.660	1.450	1.443	4.750	8:50 12:36	11:26 2:27	4.450	1.137
1/24	51	63.870	64.840	0.970	0.962	4.750	8:50 12:36	11:26 2:27	4.450	0.759
AVG										0.948
STD DEV										0.268

1/25		5	71.030	72.460	1.430	1.422	4.750		8:36	11:17		4.783	1.043	
									12:28	2:34				
	AVG												1.043	

DATE	FILTER NUMBER	CARBON, MG	HYDROGEN, MG	CORR. C, MG	CORR. H, MG	C+H, MG	C+H, MG/M**3
1/10	5	0.550	0.090	0.538	0.069	0.608	0.504
1/10	6	0.542	0.091	0.530	0.071	0.601	0.498
AVG							0.501
STD DEV							0.004
1/11	16	0.597	0.112	0.585	0.091	0.677	0.555
1/11	17	0.828	0.132	0.816	0.112	0.927	0.731
AVG							0.632
STD DEV							0.140
1/12	24	0.946	0.142	0.934	0.121	1.055	0.907
1/12	25	1.094	0.161	0.993	0.141	1.133	0.974
AVG							0.940
STD DEV							0.047
1/13	26	1.103	0.177	1.091	0.157	1.248	0.808
1/13	30	1.101	0.161	1.089	0.140	1.229	0.796
AVG							0.802
STD DEV							0.009
1/23	44	0.690	0.108	0.679	0.088	0.766	0.604
1/23	37	0.632	0.101	0.621	0.080	0.700	0.552
AVG							0.578
STD DEV							0.037
1/24	50	0.396	0.073	0.384	0.053	0.436	0.344
1/24	51	0.365	0.068	0.353	0.047	0.401	0.316
AVG							0.330
STD DEV							0.020
1/25	5	0.381	0.067	0.369	0.047	0.416	0.305
1/25	11	0.255	0.050	0.253	0.033	0.283	0.206
AVG							0.256
STD DEV							0.069

DATE	TIME OF DAY INITIAL TIME	TIME OF DAY FINAL TIME	TIME, HRS	SAMPLER NO.	PPM-HRS	NO2 PPM	CORR. FOR TEMP, PPM	CORR. FOR TEMP & INSTR, PPM
1/10	8:47	1: 1	4.233	1128	2.000	0.472	0.562	0.562
	8:47	1: 1	4.233	1087	1.500	0.354	0.422	0.422
	8:47	1: 1	4.233	1118	2.100	0.496	0.590	0.590
Avg								0.525
STD DEV								0.090
1/11	8:23	8:35	4.450	1061	2.100	0.472	0.562	0.562
	9:10	11:30						
	12:35	2:30						
	8:23	8:35	4.450	1091	2.400	0.539	0.642	0.642
	9:10	11:30						
	12:35	2:30						
	8:23	8:35	4.450	1101	2.200	0.494	0.588	0.588
	9:10	11:30						
	12:35	2:30						
Avg								0.597
STD DEV								0.041
1/12	9: 0	11:20	4.083	1044	1.600	0.392	0.466	0.466
	12:20	2: 5						
	9: 0	11:20	4.083	1074	1.200	0.294	0.350	0.350
	12:20	2: 5						
	9: 0	11:20	4.083	1103	1.300	0.318	0.379	0.379
	12:20	2: 5						
Avg								0.398
STD DEV								0.061
1/13	1:25	5: 0	5.417	1123	2.200	0.406	0.483	0.483
	5:20	7:10						
	1:25	5: 0	5.417	1125	2.100	0.388	0.461	0.461
	5:20	7:10						
	1:25	5: 0	5.417	1115	2.300	0.425	0.505	0.505
	5:20	7:10						
Avg								0.483
STD DEV								0.022

1/23								
	8:45 12:20	11:17 2:15	4.450	1199	3.600	0.809	0.963	0.963
	8:45 12:20	11:17 2:15	4.450	1200	3.200	0.719	0.856	0.856
AVG STD DEV								0.934 0.076
1/24								
	8:50 12:36	11:26 2:27	4.450	1219	2.100	0.472	0.562	0.562
	8:50 12:36	11:26 2:27	4.450	1218	2.400	0.539	0.642	0.642
	8:50 12:36	11:26 2:27	4.450	1134	3.000	0.674	0.802	0.802
AVG STD DEV								0.669 0.123
1/25								
	8:30 12:28	11:17 2:34	4.783	1104	3.600	0.753	0.896	0.896
AVG								0.896
1/26								
	9:14	11:25	2.183	1254	1.400	0.641	0.763	0.763
	9:14	11:25	2.183	1255	2.800	1.282	1.526	1.526
	9:14	11:25	2.183	1256	1.400	0.641	0.763	0.763
AVG STD DEV								1.017 0.441

		NOX			NO		
DATE		SAMPLER NO.	PPM-HRS	PPM	NOX-AVG NO2, PPM	CORR. FOR TEMP, PPM	CORR. FOR TEMP & INSTR, PPM
1/10		1067	10.400	2.457	1.932	1.990	1.990
		1078	9.000	2.126	1.601	1.649	1.649
	AVG			2.291			1.820
	STD DEV			0.234			0.241
1/11		1129	15.400	3.401	2.863	2.949	2.949
		1099	10.200	3.040	3.043	3.135	3.135
		1052	10.100	3.618	3.021	3.111	3.111
	AVG			3.573			3.065
	STD DEV			0.098			0.101
1/12		1072	11.800	2.890	2.492	2.566	2.566
		1062	11.000	2.694	2.296	2.364	2.364
	AVG			2.792			2.465
	STD DEV			0.139			0.143
1/13		1066	10.200	2.991	2.507	2.583	2.583
		1076	10.000	2.954	2.471	2.545	2.545
	AVG			2.972			2.564
	STD DEV			0.026			0.027
1/23		1192	13.600	3.056	2.147	2.211	2.211
		1198	13.200	2.966	2.057	2.119	2.119
	AVG			3.011			2.165
	STD DEV			0.064			0.065
1/24		1234	17.200	3.865	3.197	3.293	3.293
		1226	19.100	4.292	3.624	3.732	3.732
		1228	18.400	4.135	3.466	3.570	3.570

	AVG STD DEV			4.097 0.216			3.532 0.222
1/25							
		1179	15.000	3.136	2.240	2.307	2.307
		1182	12.700	2.655	1.759	1.812	1.812
		1183	13.900	2.906	2.010	2.071	2.071
	AVG STD DEV			2.899 0.240			2.063 0.248
1/26							
		1238	13.500	6.183	5.166	5.321	5.321
		1247	12.600	5.771	4.754	4.896	4.896
	AVG STD DEV			5.977 0.291			5.108 0.300

	TEMPERATURE CORRECTION FACTOR	INSTRUMENT CORRECTION FACTOR
NO2	1.190	1.000
NO	1.030	1.000

DESCRIPTION: THIS SECTION TABULATES THE FOLLOWING INFORMATION FOR EACH POLLUTANT:

* LHD
* DIFFERENCE
* % DIFFERENCE
* SLOPES OF POLLUTANTS
* CO2,% AT TLV
* % OF POLLUTANT'S TLV
* DESIRED CONTROL EFFICIENCY

PROJECT: LITTLE STOBIE MINE

DATE : JANUARY 10 - JANUARY 13,1984

FUEL INFORMATION (ASSUMED) :

BSFC = 0.440

DATE	CONVERSION OF FUEL TO SO4(%)	PERCENT SULFUR
1/10	10.00	0.190
1/11	10.00	0.190
1/12	10.00	0.190
1/13	10.00	0.190

$$AQI = CO/50 + NO/25 + RCD/2 + 1.5(SO2/3 + RCD/2) + 1.2(NO2/5 + RCD/2)$$

1979 ACGIH TLV'S AND ASSUMED LIMITS

POLLUTANT	LIMIT	BASIS OF LIMIT
CO	50.0 PPM	1979 ACGIH TLV*
NO	25.0 PPM	1979 ACGIH TLV
NO2	5.0 PPM	1979 ACGIH TLV
TPM	5.0 MG/M**3	ASSUMED
RCD	2.0 MG/M**3	ASSUMED**
SO4	1.0 MG/M**3	1979 ACGIH TLV
SO2	2.0 PPM	1979 ACGIH TLV

* ONTARIO REGULATIONS
** COAL STANDARD

POLLUTANT CONCENTRATIONS

DOWNSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10	0.105	3.10	1.32	0.52	0.84
1/11	0.080	2.00	3.06	0.60	1.24
1/12			2.46	0.40	1.78
1/13	0.118	2.60	2.56	0.48	1.19
AVG	0.101	2.57	2.48	0.50	1.26

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	0.50	0.34	0.09	0.19	1.53
1/11	0.63	0.61	-0.02	-0.04	1.52
1/12	0.94	0.84			
1/13	0.80	0.59	0.11	0.23	2.15
AVG	0.72	0.54	0.06	0.13	1.86

POLLUTANT CONCENTRATIONS

UPSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10	0.000	2.30	0.19	0.53	0.00
1/11	0.065	1.30	0.30	0.55	0.07
1/12	0.035	2.00	0.46	0.40	0.10
1/13	0.067	1.60	0.59	0.39	0.04
AVG	0.064	1.92	0.38	0.47	0.05

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	0.04	-0.04	0	0	0.32
1/11	0.05	0.03	0	0	0.31
1/12	0.08	0.02	0	0	0.30
1/13	0.06	-0.01	0	0	0.28
AVG	0.06	-0.00	0	0	0.30

DIFFERENCE, DOWNSTREAM - UPSTREAM

CONCENTRATION

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/10	0.025	0.30	1.63	-0.00	0.84
1/11	-0.005	0.70	2.77	0.05	1.17
1/12			2.01	0.00	1.69
1/13	0.031	1.00	1.97	0.09	1.15
AVG	0.017	0.64	2.09	0.03	1.21

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/10	0.46	0.38	0.09	0.19	1.18
1/11	0.59	0.53	-0.02	-0.04	1.18
1/12	0.36	0.82			
1/13	0.74	0.40	0.11	0.23	1.83
AVG	0.66	0.55	0.06	0.13	1.51

SLOPES OF POLLUTANT VS. CO2, %

DOWNSTREAM-UPSTREAM

DATE	CO2, %	CO, PPM/%	NO, PPM/%	NO2, PPM/%	TPM, MG/M**3/%
1/10	1.000	12.00	65.23	-0.12	33.48
1/11	1.000	-140.00	-553.00	-10.20	-233.40
1/12					
1/13	1.000	32.26	63.61	2.90	36.94
AVG	1.000	39.22	124.88	2.71	61.75

DATE	RCD, MG/M**3/%	TPM-RCD, MG/M**3/%	SO4, MG/M**3/%	SO2, PPM/%	AQI, AQI/%
1/10	18.44	15.04	3.56	7.57	47.29
1/11	-117.20	-116.20	3.56	7.57	-235.45
1/12					
1/13	24.00	12.94	3.56	7.57	59.13
AVG	35.12	26.63	3.56	7.57	82.20

CO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	4.2	50.0	0.6	12.0	119.0	-892.1
1/11	-0.4	50.0	1.4	-140.0	120.5	186.1
1/12						
1/13	1.6	50.0	2.0	32.3	121.1	-275.3
AVG	1.3	50.0	1.3	39.2	120.3	-206.7

NO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.4	25.0	6.5	65.3	59.5	8.8
1/11	-0.0	25.0	11.1	-553.0	60.2	110.9
1/12	-12.5	25.0	8.0	-2.0	60.2	3100.0
1/13	0.4	25.0	7.9	63.6	60.5	4.8
AVG	0.2	25.0	8.5	124.9	60.1	51.8

NO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	-41.7	5.0	-0.1	-0.1	11.9	10020.6
1/11	-0.5	5.0	1.0	-10.2	12.0	218.1
1/12	-2500.0	5.0	0.0	-0.0	12.0	602509.5
1/13	1.7	5.0	1.8	2.9	12.1	-317.0
AVG	1.3	5.0	0.9	2.7	12.0	-344.5

TPM CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.1	5.0	16.7	33.5	11.9	64.4
1/11	-0.0	5.0	23.3	-233.4	12.0	105.2
1/12	-3.0	5.0	33.7	-1.7	12.0	815.0
1/13	0.1	5.0	22.9	36.9	12.1	67.2
AVG	0.1	5.0	21.0	61.7	12.0	80.5

RCD CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.1	2.0	23.0	18.4	4.8	74.2
1/11	-0.0	2.0	29.3	-117.2	4.8	104.1
1/12	-2.3	2.0	43.1	-0.9	4.8	659.1
1/13	0.1	2.0	37.2	24.0	4.8	79.8
AVG	0.1	2.0	29.8	35.1	4.8	86.3

SO4 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.3	1.0	8.9	3.6	2.4	33.2
1/11	0.3	1.0	-1.8	3.6	2.4	32.3
1/12						
1/13	0.3	1.0	11.0	3.6	2.4	32.0
AVG	0.3	1.0	6.1	3.6	2.4	32.5

SO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-EG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.3	2.0	9.5	7.6	4.8	37.1
1/11	0.3	2.0	-1.9	7.6	4.8	36.3
1/12						
1/13	0.3	2.0	11.7	7.6	4.8	36.0
AVG	0.3	2.0	6.4	7.6	4.8	36.5

AQI CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, AQI	CONC. AS % OF TLV	ACTUAL SLOPE, AQI/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-EG CO2, AQI/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/10	0.1	4.0	29.6	47.3	9.5	79.9
1/11	-0.0	4.0	29.4	-235.4	9.6	104.1
1/12						
1/13	0.1	4.0	45.8	59.1	9.7	83.6
AVG	0.0	4.0	34.9	82.2	9.6	88.3

CO2,% AT TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/10	4.167	0.383	-41.667	0.149	0.108	0.281	0.264	0.085
1/11	-0.357	-0.045	-0.490	-0.021	-0.017	0.281	0.264	-0.017
1/12		-12.450	-2500.000	-2.967	-2.320			
1/13	1.550	0.393	1.722	0.135	0.083	0.281	0.264	0.068
AVG	1.275	0.200	1.848	0.081	0.057	0.281	0.264	0.049

CONCENTRAION AS % OF POLLUTANT'S TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/10	0.6	6.5	-0.1	16.7	23.0	8.9	9.5	29.6
1/11	1.4	11.1	1.0	23.3	29.3	-1.8	-1.9	29.4
1/12		8.0	0.0	33.7	43.1			
1/13	2.0	7.9	1.8	22.9	37.2	11.0	11.7	45.8
AVG	1.3	8.5	0.9	21.0	29.8	6.1	6.4	34.9

ACTUAL SLOPE OF POLLUTANT CHARACTERISTIC CURVE

DATE	CO PPM/%	NO PPM/%	NO2 PPM/%	TPM MG/M**3/%	RCD MG/M**3/%	SO4 MG/M**3/%	SO2 PPM/%	AQI AQI/%
1/10	12.0	65.3	-0.1	33.5	18.4	3.6	7.6	47.3
1/11	-140.0	-553.0	-10.2	-233.4	-117.2	3.6	7.6	-235.4
1/12		-2.0	-0.0	-1.7	-0.9			
1/13	32.3	63.6	2.9	36.9	24.0	3.6	7.6	59.1
AVG	39.2	124.9	2.7	61.7	35.1	3.6	7.6	82.2

DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING,%

DATE	CO %	NO %	NO2 %	TPM %	RCD %	SO4 %	SO2 %	AQI %
1/10	-892.1	8.8	10020.6	64.4	74.2	33.2	37.1	79.9
1/11	186.1	110.9	218.1	105.2	104.1	32.3	36.3	104.1
1/12		3100.0	602509.5	815.0	659.1			
1/13	-275.5	4.8	-317.0	67.2	79.8	32.0	36.0	83.6
AVG	-206.7	51.8	-344.5	80.5	86.3	32.5	36.5	88.3

AQI CHARACTERISTIC CURVE PARAMETERS

AT AVERAGE TWA CO2,% = 0.017

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.01	0.95	0.33	5.10
NO	0.04	6.08	2.09	0.80
NO2	0.02	1.32	0.45	3.70
RCD	1.09	79.03	27.21	0.06
SO4	0.11	8.02	2.76	0.61
SO2	0.06	4.60	1.59	1.06
TOTAL	1.38	100.00	34.42	

AT MAXIMUM TWA CO2,% = 0.031

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.02	0.95	0.61	5.10
NO	0.15	6.08	3.87	0.80
NO2	0.03	1.32	0.84	3.70
RCD	2.01	79.03	50.35	0.06
SO4	0.20	8.02	5.11	0.61
SO2	0.12	4.60	2.93	1.06
TOTAL	2.55	100.00	63.71	

FREQUENCY AT WHICH CO2,% EXCEEDS CO2 AT AQI = 4 : 0

MAXIMUM ALLOWABLE CO2,% AT AQI = 4 : 0.049
EQUIVALENT CFM/BHP : 408.54

ORDER OF POLLUTANTS ACCORDING TO AQI
(LEAST TO MOST CRITICAL)
CO NO2 SO2 NO SO4 RCD

ORDER OF POLLUTANTS ACCORDING TO TLV OR ASSUMED LIMIT
(LEAST TO MOST CRITICAL)
NO2 CO SO4 SO2 NO RCD AQI

POLLUTANT OR INDEX	TLV OR LIMIT	TYPICAL AMBIENT SLOPE	LIMITING AMBIENT SLOPE AT 0.15% CO2	DETERIORATION FACTOR
CO	50.00	39.22	333.33	8.50
NO	25.00	124.88	166.67	1.33
NO2	5.00	2.71	33.33	12.32
RCD	2.00	35.12	13.33	0.38
SO4	1.00	3.56	6.67	1.87
SO2	2.00	7.57	13.33	1.76
AQI	4.00	82.20	26.67	0.32
CO/50 +NO/25	1.00	1.63	6.67	4.08

DESCRIPTION: THIS SECTION TABULATES THE FOLLOWING INFORMATION FOR EACH POLLUTANT:

* LHD
* DIFFERENCE
* % DIFFERENCE
* SLOPES OF POLLUTANTS
* CO2% AT TLV
* % OF POLLUTANT'S TLV
* DESIRED CONTROL EFFICIENCY

PROJECT: LITTLE STOBIE MINE

DATE : JANUARY 23 - JANUARY 26,1984

FUEL INFORMATION (ASSUMED) :

BSFC = 0.440

DATE	CONVERSION OF FUEL TO SO4(%)	PERCENT SULFUR
1/23	2.50	0.230
1/24	2.50	0.230
1/25	2.50	0.230

AQI = CO/50 + NO/25 + RCD/2 + 1.5(SO2/3 + RCD/2) + 1.2(NO2/3 + RCD/2)

1979 ACGIH TLV'S AND ASSUMED LIMITS

POLLUTANT	LIMIT	BASIS OF LIMIT
CO	50.0 PPM	1979 ACGIH TLV*
NO	25.0 PPM	1979 ACGIH TLV
NO2	5.0 PPM	1979 ACGIH TLV
TPM	5.0 MG/M**3	ASSUMED
RCD	2.0 MG/M**3	ASSUMED**
SO4	1.0 MG/M**3	1979 ACGIH TLV
SO2	2.0 PPM	1979 ACGIH TLV

* ONTARIO REGULATIONS
** COAL STANDARD

POLLUTANT CONCENTRATIONS

DOWNSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.093	3.00	2.16	0.91	1.30
1/24	0.113	3.20	3.53	0.67	0.95
1/25	0.099	2.07	3.59	0.96	1.04
AVG	0.103	2.76	3.10	0.84	1.10

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.58	0.72	0.04	0.37	1.84
1/24	0.33	0.62	0.06	0.54	1.46
1/25	0.26	0.79	0.03	0.31	1.26
AVG	0.39	0.71	0.04	0.40	1.52

POLLUTANT CONCENTRATIONS

UPSTREAM

DATE	CO2, %	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.061	2.00	0.42	0.34	0.20
1/24	0.059	2.00	0.32	0.60	0.17
1/25	0.063	1.27	0.96	0.57	0.14
AVG	0.063	1.76	0.57	0.50	0.17

DATE	RCD, NG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.02	0.18	0	0	0.22
1/24	0.06	0.11	0	0	0.36
1/25	0.06	0.08	0	0	0.36
AVG	0.05	0.13	0	0	0.31

DIFFERENCE, DOWNSTREAM - UPSTREAM

CONCENTRATION

DATE	CO2,%	CO, PPM	NO, PPM	NO2, PPM	TPM, MG/M**3
1/23	0.037	1.00	1.74	0.57	1.09
1/24	0.054	1.20	3.22	0.07	0.78
1/25	0.031	0.81	2.63	0.38	0.91
AVG	0.041	1.00	2.53	0.34	0.92

DATE	RCD, MG/M**3	TPM-RCD, MG/M**3	SO4, MG/M**3	SO2, PPM	AQI, AQI
1/23	0.55	0.54	0.04	0.37	1.60
1/24	0.27	0.50	0.06	0.54	1.06
1/25	0.20	0.71	0.03	0.31	0.86
AVG	0.34	0.58	0.04	0.40	1.17

SLOPES OF POLLUTANT VS. CO2,%

DOWNSTREAM-UPSTREAM

DATE	CO2,%	CO, PPM/%	NO, PPM/%	NO2, PPM/%	TPM, MG/M**3/%
1/23	1.000	27.03	47.14	15.30	29.51
1/24	1.000	22.22	59.54	1.31	14.35
1/25	1.000	25.97	84.84	12.35	29.19
AVG	1.000	24.63	62.20	8.36	22.72

DATE	RCD, MG/M**3/%	TPM-RCD, MG/M**3/%	SO4, MG/M**3/%	SO2, PPM/%	AQI, AQI/%
1/23	15.00	14.51	1.08	9.93	43.25
1/24	5.02	9.33	1.03	9.93	19.59
1/25	6.42	22.77	1.03	9.93	27.69
AVG	8.40	14.32	1.08	9.93	28.83

CO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	1.9	50.0	2.0	27.0	113.9	-321.4
1/24	2.2	50.0	2.4	22.2	113.4	-410.2
1/25	1.9	50.0	1.6	26.0	115.7	-345.7
AVG	2.0	50.0	2.0	24.6	114.3	-364.2

NO CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.5	25.0	7.0	47.1	56.9	-20.3
1/24	0.4	25.0	12.7	39.5	56.7	4.8
1/25	0.3	25.0	10.3	84.8	57.9	31.8
AVG	0.4	25.0	10.1	62.2	57.2	8.1

NO2 CHARACTERISTIC CURVE P METERS

DATE	CO2,% AT TLV	TLV, PPM	CONC. AS % OF TLV	A L P CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.3	5.0	11.3	15.3	11.4	25.5
1/24	3.8	5.0	1.4	1.3	11.3	-762.3
1/25	0.4	5.0	7.7	12.4	11.6	6.3
AVG	0.6	5.0	6.8	8.4	11.4	-36.7

TPM CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.2	5.0	21.8	29.5	11.4	61.4
1/24	0.3	5.0	15.5	14.4	11.3	21.0
1/25	0.2	5.0	[illegible]	29.2	11.6	60.4
AVG	0.2	5.0	.5	22.7	11.4	49.7

RCD CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.1	2.0	27.7	15.0	4.6	69.6
1/24	0.4	2.0	13.6	5.0	4.5	9.6
1/25	0.3	2.0	10.0	6.4	4.6	27.9
AVG	0.2	2.0	17.1	8.4	4.6	45.6

SO4 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2,% AT TLV	TLV, MG/M**3	CONC. AS % OF TLV	ACTUAL SLOPE, MG/M**3/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, MG/M**3/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.9	1.0	4.0	1.1	2.3	-111.3
1/24	0.9	1.0	5.8	1.1	2.3	-110.4
1/25	0.9	1.0	3.3	1.1	2.3	-114.8
AVG	0.9	1.0	4.4	1.1	2.3	-112.1

SO2 CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, PPM	CONC. AS % OF TLV	ACTUAL SLOPE, PPM/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, PPM/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.2	2.0	18.4	9.9	4.6	54.1
[illegible]4	0.2	2.0	26.8	9.9	4.5	54.3
1/25	0.2	2.0	15.4	9.9	4.6	53.4
AVG	0.2	2.0	20.2	9.9	4.6	53.9

AQI CHARACTERISTIC CURVE PARAMETERS

DATE	CO2, % AT TLV	TLV, AQI	CONC. AS % OF TLV	ACTUAL SLOPE, AQI/%CO2	SLOPE THAT PASSES THROUGH TLV AT 0.5%-BG CO2, AQI/%CO2	DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING, %
1/23	0.1	4.0	40.0	43.3	9.1	78.9
1/24	0.2	4.0	26.5	19.6	9.1	53.7
1/25	0.1	4.0	21.5	27.7	9.3	66.6
AVG	0.1	4.0	29.3	28.8	9.1	68.3

CO2, % AT TLV

DATE	CO	NO	NO2	TPM	RCD	SO4	SO2	AQI
1/23	1.850	0.530	0.327	0.169	0.133	0.928	0.201	0.092
1/24	2.250	0.420	3.803	0.348	0.399	0.928	0.201	0.204
1/25	1.925	0.295	0.405	0.171	0.312	0.928	0.201	0.144
AVG	2.030	0.402	0.598	0.220	0.238	0.928	0.201	0.139

CONCENTRAION AS % OF POLLUTANT'S TLV

DATE	CO	NO	NO2	TPM	CD	SO4	SO2	AQI
1/23	2.0	7.0	11.3	21.8	27.7	4.0	18.4	40.0
1/24	2.4	12.9	1.4	15.5	13.6	5.8	26.8	26.5
1/25	1.6	10.5	7.7	18.1	10.0	3.3	15.4	21.5
AVG	2.0	10.1	6.8	18.5	17.1	4.4	20.2	29.3

ACTUAL SLOPE OF POLLUTANT CHARACTERISTIC CURVE

DATE	CO PPM/%	NO PPM/%	NO2 PPM/%	TPM MG/M**3/%	RCD MG/M**3/%	SO4 MG/M**3/%	SO2 PPM/%	AQI AQI/%
1/23	27.0	47.1	15.3	29.5	15.0	1.1	9.9	43.3
1/24	22.2	59.5	1.3	14.4	5.0	1.1	9.9	19.6
1/25	26.0	84.8	12.4	29.2	6.4	1.1	9.9	27.7
AVG	24.6	62.2	8.4	22.7	8.4	1.1	9.9	28.8

DESIRED CONTROL EFFICIENCY WITH CO2 LIMITING,%

DATE	CO %	NO %	NO2 %	TPM %	RCD %	SO4 %	SO2 %	AQI %
1/23	-321.4	-20.8	25.5	61.4	69.6	-111.3	54.1	78.9
1/24	-410.2	4.8	-762.3	21.0	9.6	-110.4	54.3	53.7
1/25	-345.7	31.8	6.3	60.4	27.9	-114.8	53.4	66.6
AVG	-364.2	8.1	-36.7	49.7	45.6	-112.1	53.9	68.3

AQI CHARACTERISTIC CURVE PARAMETERS

AT AVERAGE TWA CO2,% = 0.041

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.02	1.71	0.50	8.12
NO	0.10	8.63	2.53	1.61
NO2	0.14	11.60	3.40	1.20
RCD	0.63	53.92	15.80	0.26
SO4	0.08	6.92	2.03	2.01
SO2	0.20	17.22	5.05	0.81
TOTAL	1.17	100.00	29.31	

AT MAXIMUM TWA CO2,% = 0.054

POLLUTANT	AQI CONTRIBUTION	% OF TOTAL AQI	% OF AQI LIMIT	CO2,% AT AQI = 4
CO	0.03	1.71	0.67	8.12
NO	0.13	8.63	3.36	1.61
NO2	0.18	11.60	4.51	1.20
RCD	0.84	53.92	20.98	0.26
SO4	0.11	6.92	2.69	2.01
SO2	0.27	17.22	6.70	0.81
TOTAL	1.56	100.00	38.92	

FREQUENCY AT WHICH CO2,% EXCEEDS CO2 AT AQI = 4 : 0

MAXIMUM ALLOWABLE CO2,% AT AQI = 4 : 0.139
EQUIVALENT CFM/BHP : 143.26

ORDER OF POLLUTANTS ACCORDING TO AQI
(LEAST TO MOST CRITICAL)
CO SO4 NO NO2 SO2 RCD

ORDER OF POLLUTANTS ACCORDING TO TLV OR ASSUMED LIMIT
(LEAST TO MOST CRITICAL)

CO SO4 NO2 NO RCD SO2 AQI

POLLUTANT OR INDEX	TLV OR LIMIT	TYPICAL AMBIENT SLOPE	LIMITING AMBIENT SLOPE AT 0.15% CO2	DETERIORATION FACTOR
CO	50.00	24.63	333.33	13.53
NO	25.00	62.20	166.67	2.68
NO2	5.00	8.36	33.33	3.99
RCD	2.00	8.40	13.33	1.59
SO4	1.00	1.08	6.67	6.18
SO2	2.00	9.93	13.33	1.34
AQI	4.00	28.83	26.67	0.93
CO/50 +NO/25	1.00	1.02	6.67	6.56

POOR

QUALITY

ORIGINAL